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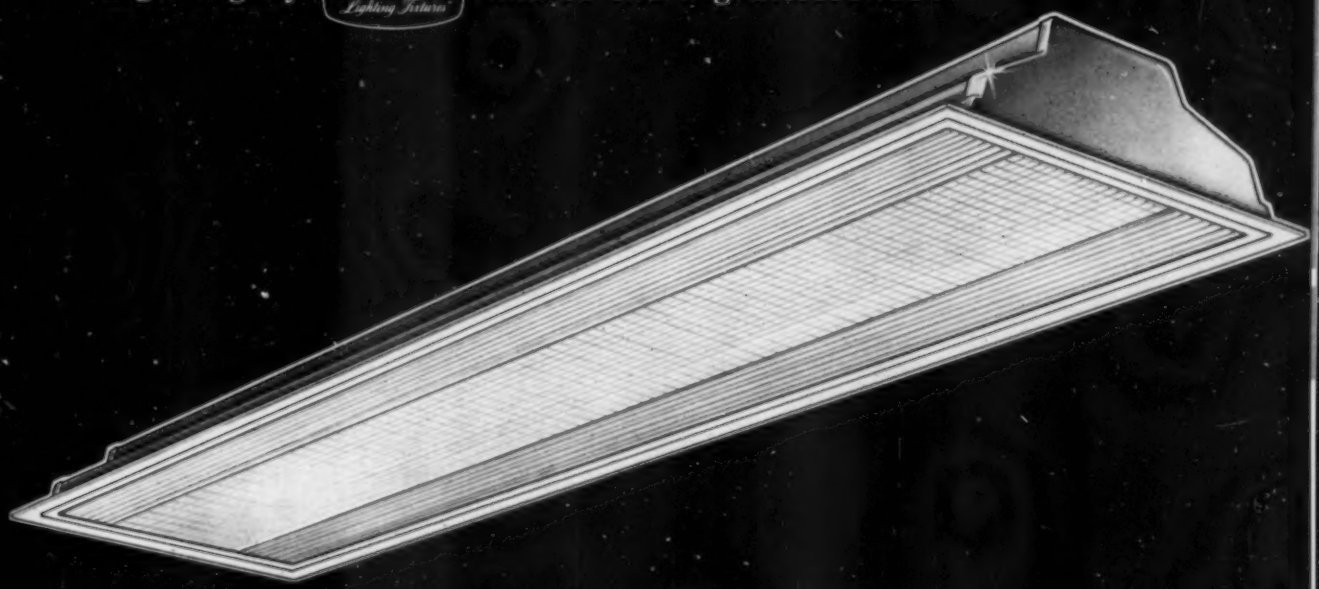

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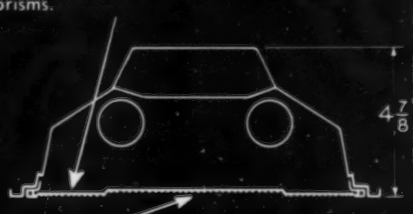

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ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

September 1956

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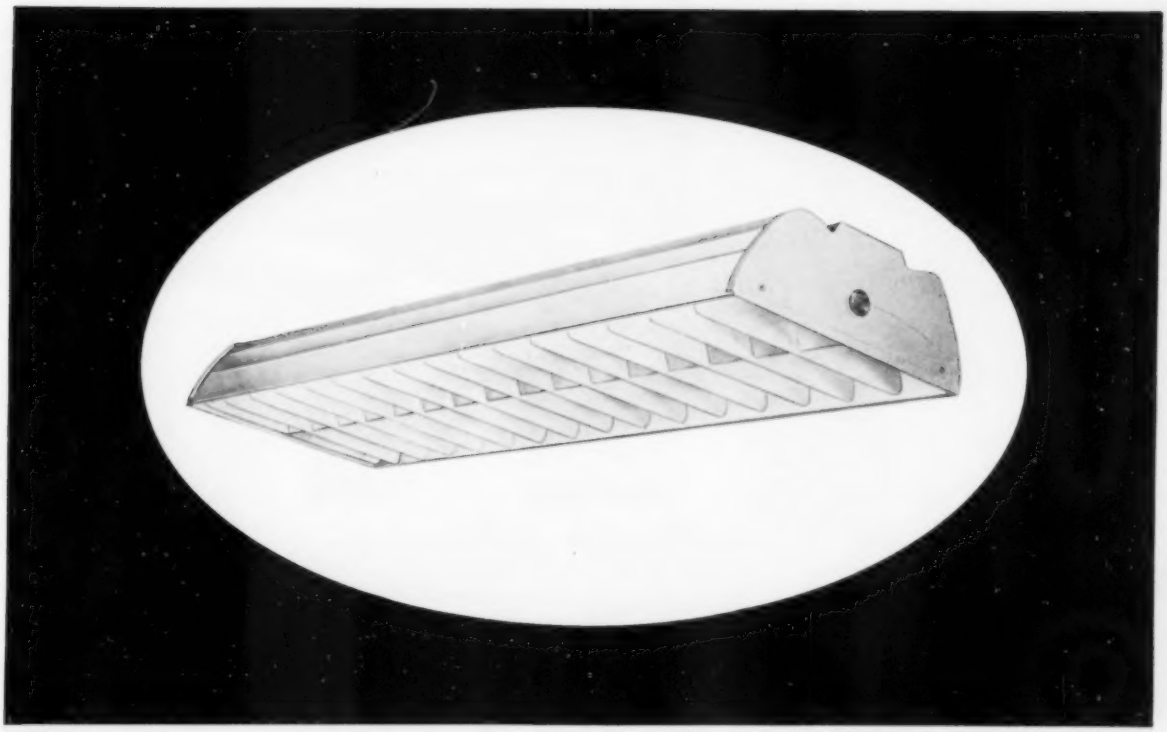

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By R. F. HARTENSTEIN
President, 1955-1956

The President's Golden Anniversary Address

THE 50TH Anniversary Year of our Society will soon be history. To have our National Technical Conference here in Boston is a fitting climax to an unusually eventful year. Fitting because our first National Convention, as it was then known, was also held in this city.

During this Conference we are acknowledging in many appropriate ways the farsightedness of the founders of our Society. From the very beginning they saw not only the advantages of an Illuminating Enginering Society, but also some of the great future potentials of lighting. Even so, how amazed they would be if they could gather here with us in Boston today to look upon the advancements that have been made since that first I.E.S. Convention. I am sure they would be astounded to learn of the veritable miracles their descendants have performed in contributing to the comfort and well being of nearly all of the 165,000,000 people living and working in our nation today. Is it any wonder that this 50th Anniversary Year has been filled with I.E.S. activities, events and celebrations?

To begin with, nearly all of our Sections and Chapters had at least one meeting with the I.E.S. 50th Anniversary as the keynote. And in addition, overall activities throughout the Society showed marked increase during this anniversary year.

It is a pleasure to report that the nine Regional Conferences held during 1956 set a new record in total attendance. I would like to express my sincere appreciation to the Section and Chapter officers and to the Regional Program Committees responsible for this successful activity. Last, but by no means least, I salute our Regional Vice-Presidents who turned in magnificent records of achievements during the year. They are continuing to give excellent leadership and guidance to the Sections and Chapters in their respective Regions.

I also want to thank the Regional Vice-Presidents and members of the Regional Conference Committees for the attention, far beyond the call of duty, that was given to my wife and me at each of the Regional Conferences. We both enjoyed meeting so many members of the Society. We will always remember how gracious they were to both of us.

I wish to compliment the Regional Publicity Chairmen for the excellent publicity the Society received from newspapers in every city where the 1956 Conferences were held. I don't believe we ever before received such wide publicity. This accomplishment was due in part, I am sure, to the fact that each Regional Publicity Chairman was aided by news releases furnished by our Public Relations Consultant, Herbert Cornell.

Our Regional Activities Committee has been very active during the year under the capable leadership of our Junior Vice-President Kirk Reid. The work of this committee is of great assistance to Council. At their meetings, which were usually held the day before Council meetings, they discussed problems in the various Regions and brought recommenda-

tions to Council that were well thought out and very carefully reviewed. One especially important recommendation of this committee was presented to Council in June. This was for the formation of an additional Region of I.E.S. For some time consideration had been given to dividing the Southern Region into two Regions. Its territory included all or parts of 10 states. There were within its boundaries 12 Sections and Chapters with still more in prospect. With this number of Sections and Chapters spread over such a large area, the Regional Activities Committee and Council realized the difficulty of the Regional Vice-President properly to look after and serve all of these groups. Therefore, upon recommendation of the Regional Vice-President of the Southern Region, with approval of all the Sections and Chapters in this Region, the Regional Activities Committee approved and presented to Council for action the division of the Southern Region into two Regions, each with a Regional Vice-President. Approval was given by Council at its June meeting. This division will be effective October 1, 1956. The Regions will be known as the Southeastern Region, to include three Sections and three Chapters; and the South Central Region, to include three Sections and three Chapters. The number of I.E.S. Regions has thus been increased from 10 to 11.

Locally, Sections and Chapters had an unusually active year. It was also very gratifying to me to see the increased interest in establishing new Chapters. During the year four were chartered, bringing the total Sections and Chapters in the Society to 75. The four new Chapters will be known as the Panhandle Chapter, Amarillo, Texas; Edmonton Chapter with headquarters at Edmonton, Province of Alberta, Canada; Yankee Chapter with headquarters at Springfield, Massachusetts; and the Chinook Chapter, in Calgary, Province of Alberta, Canada.

Our Publications Committee and Headquarters Publication Staff certainly deserve a "pat on the back" for the outstanding January Anniversary issue of ILLUMINATING ENGINEERING. Many complimentary letters have been received at Headquarters regarding this particular issue. This Committee and Staff are constantly striving to improve our monthly publication and publish our Technical and Conference material for use by all of our members. "IE" is a readable magazine. It is the one visible, valuable and frequent contact between the Society and its members. During the year this Committee also published a revised edition to "IES Dividends," which was distributed at Regional Conferences and sent to all Sustaining Members. In order to add a personal touch to the copies sent to Sustaining Members, a letter over my signature called attention to this annual report and pointed out that it gave a picture of the Illuminating Engineering Society's contribution to the lighting industry and to the public served by that industry.

Another all-year event deserving recognition was the work of our Membership Committee in obtaining new members. Altogether 1178 members were added to the Society through the cooperation of the National Committee and the Section and Chapter Membership Committees. Our total membership at the close of the year was 8,480. It is my sincere hope that next year our Section or Chapter officers and Membership Committees will take a personal interest in each member with the objective of having *all* members actively participate in the Society's program.

Another outstanding event and achievement was our extensive Sustaining Membership Drive. Fred Guth, National Committee Chairman, and his committees throughout the country set a record that will be hard to beat in obtaining new Sustaining Members, reinstating old members and obtaining increases in dues from present members. As a result of the efforts of the Sustaining Membership Committee, over $23,000 was added to our Sustaining Membership dues over the year.

As a result of Council action two-thirds of the increase in Sustaining Membership dues unless otherwise designated, will be allocated to Research projects. This will permit many more such projects to be initiated. I am sure the Board of Trustees of the Research Institute will welcome these additional funds.

The Technical Committee's effective work during the year cannot be overlooked. It would take much time to enumerate all of the worthwhile projects on which the 72 Technical Committees or important Subcommittees have worked. Instead, I would like to report that the year has been highlighted by a vigorous endeavor to spell out the provisions of practice to provide quality of lighting. This was keynoted earlier in the year at the Technical Committee Forum where the Technical Committee Chairmen stressed the need for more knowledge of the relationships which lead to better seeing. The Recommended Practice of Office Lighting, which was completed and published in the June issue of ILLUMINATING ENGINEERING, spearheaded a new approach to lighting comfort. It is interesting that this new material springs directly from research on discomfort glare. It is becoming very clear that advances in techniques will become available only as research brings about new knowledge. Our Technical

Committees are always active. We must remember that they are the backbone of our Society's advancement. We need a faster tempo in the completion of important Technical reports and standards. These reports are generally accepted as "gospel" not only by our own members, but by many other related groups. At present it takes at least three years to prepare one recommended practice. It behooves every chairman accepting an assignment leading to the preparation of a report to diligently keep the project going and to try to iron out minor differences which sometimes delay for months the completion of reports and standards. It is my earnest hope that we will be able to speed up these important projects.

I was pleased with the splendid vote of confidence the members of the Society gave your Council in approving by a substantial vote the increases in dues which will become effective October 1, 1956. This added revenue will permit bringing to fruition added services so necessary if our Society is to match in growth and stature the growth of the lighting industry. I have asked President-Elect Waterman to include in his presentation the added services planned for next year.

The membership of the Society voted approval of a new grade of member to be known as "Retired member." A Retired member shall be an individual member who has retired from regular occupation or business and who has been in good standing in the Society for a period of thirty years and who is not less than 65 years of age. Retired members shall be entitled to all privileges of the Society except the right to hold elective office. Your Council is of the opinion that there will not be many members who will apply for this grade. However, some Retired members will undoubtedly wish to stay in the Society by paying the annual dues that will be set at $5.00 per year.

Early in the year a special Headquarters Task Committee was appointed to study the crowded conditions of our Headquarters office. It developed a plan to use the balance of the floor previously sublet. Council considered and approved the committee's recommendations in view of the increased demands upon our Headquarters Staff. We are at the present time in the process of revamping the area. With this added space our Headquarters Personnel can work more efficiently and effectively. With this improvement, we believe that our present Staff can handle the increasing volume of work resulting from our growing membership, the increased number of Sections and Chapters and the added services we plan to inaugurate.

Every President of this Society, through his association with the officers, Council members, Regional Vice-Presidents, Section and Chapter officers, many committees and members, has visualized the needs of the Society, and I am no different. So, this morning I would like to have you consider the following suggestions:

Suggestion 1—That our Educational Committee prepare material that can be used in high schools and colleges to interest students in considering illuminating engineering as a career. According to the report of our Lighting Education Committee, 3000 more technically trained persons will be needed in the electrical illuminating industry in the next five years. If we are to do our part in interesting students in illuminating engineering, we will have to do a better job of selling high schools and colleges on the need for Illumination Courses. I believe it is a function of the I.E.S. Lighting Education Committee to prepare material that can be presented to these institutions.

Suggestion 2—That a Task Committee be appointed to study the advisability of preparing an Education Training Program for utilities, lamp and fixture manufacturers and others interested. This might be divided into two major parts. The first part could be on the Fundamentals of Illumination and the second on Advanced Lighting Application Studies, arising from the training obtained in the Fundamentals course. I believe that such a course, with carefully prepared text and perhaps slides, would be self-supporting. By making such training aids available for the education of new lighting personnel, the Society would fulfill an important responsibility and would so render a valuable service to the industry.

Suggestion 3—Greater progress could be made, it seems to me, in Student Branches, if a general Student Branch Committee were appointed to solve the many problems confronting Student Branches. I might cite you an example of what a special committee for this project might accomplish. Note the splendid work that was done this year after the general Allied Arts Committee was formed. Although appointed less than one year ago, this committee has, through the efforts of its Chairman, Karl Staley, increased the two or three Allied Arts Competitions previously held this year, to 15 scheduled next year. I believe the same could be true in establishing new Student Branches. I am sure we all realize that enrolling

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I.E.S. Aims, for 1956-1957

By **MARSHALL N. WATERMAN**
President-Elect

OUR SOCIETY in 1956-1957 will certainly be bigger than ever. This we know. With the help of all the members, it can also be better than ever.

Bigness, however, is a virtue only if it is accompanied by good organization; good coordination. Otherwise it is clumsy, slow. Bigness requires a large sense of responsibility to others. For example, we hear frequently of the responsibility required of big business and big nations. Bigness in this sense implies being a target of criticism, because it means having a large influence.

The increased bigness of I.E.S. seems to fall most naturally under four different subheads.

1. Bigger — in numbers. More members; more Sustaining Members.
2. Bigger — financially. More income; and more expense.
3. Bigger in terms of the responsibility and burden of work placed on elected officers and on headquarters staff.
4. Bigger Services — to the public and to the membership.

Bigger in Numbers

The Society will start the year with 8,480 members; 305 more than a year ago. Ten years ago the membership totalled 4,946, so we have continued to grow at the rate of about 71 per cent in this period. Figuring conservatively, we would, at this rate, number 14,450 members ten years hence, in 1966. Some think we can do better than this. Be that as it may, I.E.S. membership will be bigger next year than it was this year, and to our current figures we may also add Sustaining Members as Fred Guth and his committee forge still farther ahead.

For a bigger membership we must plan ahead for still further service in the years to come.

Bigger Financially

In terms of dollars, I.E.S. is now a $300,000 per year operation. Our proposed budget, to be voted on by Council this week, will be about $321,500, or 15 per cent larger than last year. This increase comes from larger dues from more members, larger Sustaining Member contributions, and greater income from the publications operation, especially advertising in ILLUMINATING ENGINEERING. I will speak later about the use of this larger income, but right now I want merely to make the point of a bigger Society, financially. This, of course, means greater responsibility and increased opportunity for better services to the public and to the membership.

Bigger Responsibility

There are, of course, many problems arising from this growth in membership and budget. As noted, this points to a greater responsibility and work load on the headquarters staff and on the elected officers, from the Chapters and Sections through the Regional Vice-Presidents and the na-

tional officers. Ten years ago we had 32 Sections and Chapters. Now we have 75. Our total budget then was $80,961. Now it is more than $300,000. The membership numbered 4946; now it is close to 8500. Ten years ago we had a headquarters staff of 12. Today we have 18, only six more people. More members, more Sections and Chapters, more technical activities, an expanded publications program means that the volume of work at headquarters is inevitably much greater. Much thought will have to be given to the problems thus created.

President Hartenstein has told you of the improvements in our headquarters space. The expense of this, while decreasing somewhat our gain in income, was nevertheless a necessity and a good business investment. Looking ahead it seems clear that there will need to be still further study of the organization structure to handle the larger load. The burden of work, time and travel of the R.V.P.'s and national officers has become very heavy and requires business-like examination. There are sound reasons for feeling that something must be done to reduce the burden and still enable these men to carry the load necessary for rendering still better services to still more members.

The principal objective is to reduce the required time and expense so that we shall run less risk of having the men we want as our leaders turn down the opportunity because they do not feel they can afford it, either in time or in money.

Considerations of this problem which have already been discussed in Council, include better organization of the headquarters operation so that staff work can further simplify the work of the officers. There is also a study underway on the possibility of reducing the number of trips required for Council meetings, to New York or elsewhere. For example, the first meeting of the new Council for 1956-1957 is being held here in Boston at this hotel next Friday, while the Council members are gathered for this Conference. This will replace the Council meeting usually scheduled for October in New York City.

Another consideration which will come before the Council on Friday is a budget item for some financial allowance to Regional Vice-Presidents to apply against the cost of their trips to visit their constituent Sections and Chapters.

There is room for much debate and hard thinking, policy-wise, on these matters. However, we will have these bigger responsibilities before us in 1956-1957. We must meet them, must resolve them, and be ready for a still bigger and better future.

Bigger Services

President Hartenstein has asked me to say something about the added services which have been planned for next year as a result of added revenue. It is without apology that I remind you that I can do this only in general terms since, as you know, all allocations of your money are made by the Council who will see the proposed new budget for the first time on Friday. However, I can tell you something of the thinking which is represented in the budget proposals, stemming from discussions during last year in the President's Advisory Board, in the Regional Activities Committee, in the Finance Committee and elsewhere.

I have already mentioned one project, that of expanding and renovating headquarters space. In addition, if Council approves, a new appropriation will be allotted to Regional Vice-President's travel.

The new budget proposal, as always, will place much emphasis on support of Section and Chapter programs. There will be an enlarged appropriation to provide additional prizes for the new two-part contest for "My Most Interesting Lighting Job," which Council approved in principle in June. There will be a proposal for a sizeable allotment for the many Allied Arts or similar competitions which are known to be scheduled next year. Additional assistance to Student Branches, both those presently organized and new ones to come, will be one of the services it is hoped to provide. Wider spread extension activities through Local Representatives are scheduled for consideration. Taken altogether, the new services to local programs are estimated to require more than 15 per cent increase over appropriations for similar activities this past year.

Among the technical activities of the Society next year, an important operation will be the revision of the *I.E.S. Lighting Handbook*. Guided by Council and a special Handbook Committee under John Neidhart as Chairman, all of our technical committees and our technical staff at headquarters will have this as a major project throughout the entire year. Augmented service to the technical committees is planned in terms of increased travel to committee meetings, with Mr. Crouch's new assistant, John Kaufman, beginning to participate.

The seeds for a larger harvest of new knowledge about light, lighting and seeing, will be sown next year by new research projects, made possible by new income largely from Sustaining Members.

Thus there are plans for bigger and better technical services; for more support of Section and

Chapter programs, and provision to enable the headquarters staff to serve a bigger Society.

The foregoing will, I believe, serve to explain in a general way the new services which will more than consume our gains in income from dues. The budget for 1956-1957 will again be healthily tight. While it will be adequate for an expansion of the services I have mentioned, good business management will be required, and a keen eye to economy and efficient use of your money. Furthermore, still more services are hopefully on the docket for next year. President Hartenstein mentioned one, in his suggestion that material be made available for use in colleges and high schools to direct the interest of students to illuminating engineering. Lighting educational material and a broader public relations and information program are among other services on which effort is planned.

In conclusion, then, I repeat that our Society will definitely be bigger than ever in 1956-1957. It will be bigger in terms of membership, finances, responsibilities, and work load. It will also be bigger in terms of more and better services to the public and to you and me, its members. I am sure that with your help, our Society will not only be bigger than ever but that it can also be better than ever, because we have more substance and a great opportunity.

Hartenstein — The President's Golden Anniversary Address

(continued from page 603)

college students in I.E.S. Student Branches will help us to interest more of them in Illumination as a career.

Suggestion 4 — It has been my pleasure this year to visit quite a few Sections and Chapters. During these visits it occurred to me that more recognition should be given to new members. In only one Section meeting were the new members made welcome. I would suggest that they should be identified in some manner at every Section or Chapter meeting.

Suggestion 5 — At the Local Activities meetings held during Regional Conferences this year, I was surprised to learn that many of the Section and Chapter officers, even though they had been furnished guides immediately after their election in June, do not get started outlining their plans for the year until October. It is my opinion that new Section and Chapter officers should meet with the outgoing officers not later than July 15, at which time they should discuss plans for the year, appoint committee chairmen and discuss possible programs. By so doing, I believe they could outline the whole year's program before the first of October.

Suggestion 6 — At these Local Activities Committee meetings, I also learned that many Sections or Chapters do not know what others in the Region are doing. Perhaps an interchange of programs would be helpful. In many cases joint programming might make it possible to obtain distant speakers. It is my sincere hope that the Regional Vice-Presidents will see that this is done next year.

Suggestion 7 — During my travels I found in numerous cases that there is not close cooperation between the Section or Chapter Chairmen and the Local Representatives. At the present time each Local Representative reports to the Regional Vice-President. Perhaps the situation could be remedied by having Local Representatives report to each Section and Chapter Chairman, since it is, in effect, a local problem. I recommend that consideration be given to amending the By-Laws to bring this about.

I am indeed grateful for the assistance given me during the year by our official family, our efficient headquarters staff and for the support I received from all of the members. I want to pay tribute to the New England Section, our hosts during this Conference, and especially to the committees and the New England Coast members who have done so much to make this Conference program one which I am sure will long be remembered. I am grateful for the honor of having served as your President during our 50th Anniversary Year. It has been a privilege that I shall always cherish.

Abstracts of
I.E.S. Conference Papers on

Light Sources

Fluorescent Lamp Performance As Affected by Impurity Gases

Richard W. Mooney

W. Calvin Gungle

THE DECLINE of lumen output during the normal burning of fluorescent lamps has been studied extensively, but the role played by specific gases in this decline has not previously been completely clarified. Various theories have been proposed to account for the drop in efficiency with burning time and a mathematical expression was developed by Lowry and Butler[1] which analytically accounts for this phenomenon. According to one of the assumptions inherent in this equation, the effect of impurity gases should be apparent in the "*A*" term of the equation. The results of this study show this assumption to be valid.

Twenty-watt bulbs were coated with acid washed calcium halophosphate phosphor. (3500° white). Oxygen, nitrogen, carbon dioxide, sulphur dioxide, hydrogen, water vapor, methane, and ethylene were quantitatively mixed with spectroscopically pure argon to form fill gases of various degrees of purity. With the exception of the fill gas admission, the processing procedure was normal and was identical for all lamps tested. The effects of these impurity gases on the initial starting characteristics, maintenance, and discoloration after burning were examined and interpreted in terms of the chemical constitution of the impurities.

The most pronounced effect was noticed in the maintenance data of these lamps as analyzed by means of the Butler-Lowry equation using a least squares method. The results may be summarized as follows: small concentrations of nitrogen seem to be advantageous whereas oxygen, carbon dioxide, and sulphur dioxide have little, if any, effect. On the other hand, the presence of water vapor, hydrogen, methane, or ethylene results in serious degradation of lumen output. Those gases which have the greatest effect have one thing in common, namely, hydrogen atoms in the molecular structure. It was soon found that a straight line relationship exists between the 100-hour efficiency expressed in lumens per watt or lumens per milliampere vs. the

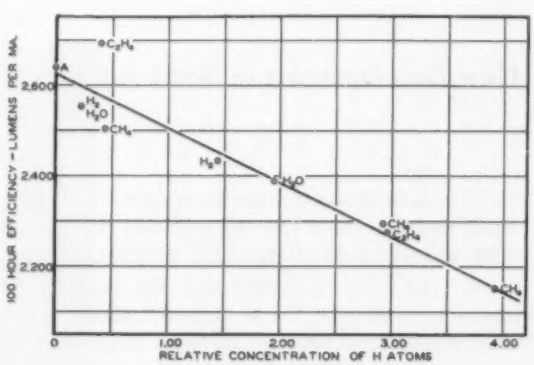


Figure 1. The effect of H atom concentration on 100-hour efficiency values.

AUTHORS: Sylvania Electric Products Inc., Towanda, Pa., and Salem, Mass., respectively.

concentration of hydrogen atoms. A similar relationship exists between the "*A*" terms of the Butler-Lowry equation and the concentration of hydrogen atoms. Fig. 1 shows this straight line relationship for the data expressed in lumens per milliampere. On the basis of this relationship, it was concluded that hydrogen containing gases are completely broken down in the arc discharge to their atomic constituents. Thus, all of the hydrogen in hydrogen-containing compounds eventually ends up in the atomic state. As is well known, hydrogen in this form is extremely reactive, and therefore it is proposed that this active hydrogen is responsible for the initial drop in lumen output during the first 200 hours of operation.

The data on the initial starting characteristics and discoloration are in general agreement with the results found in the maintenance study, namely that hydrogen-containing gases are by far the worst offenders in producing hard starting lamps or severe discoloration.

The practical implications of these results are that extreme care should be taken to avoid the possibility of phosphor contamination by water vapor, hydrogen, or hydrocarbons. On the other hand, the presence of small amounts of nitrogen, oxygen, or gaseous oxides will not result in serious trouble in fluorescent lamp maintenance. It has also been shown that the basic assumption of the Butler-Lowry equation regarding the effect of gaseous impurities is sound.

1. Lowry, E. F.: "A Study of Fluorescent Lamp Maintenance," ILLUMINATING ENGINEERING, Vol. XLIII, p. 141 (1948); Lowry, E. F. and Mayer, E. L.: "Some Factors Affecting the Life and Lumen Maintenance of Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. XLIV, p. 98 (1949).

(Abstract of Conference Paper No. 16)

Theodore C. Retzer

George W. Gerung

New Developments in Short Arc Lamps

THERE HAS ALWAYS been a need for a brilliant, long-life, bulb-type light source for use in high powered searchlights and projection equipment. The high brightness and the long life of mercury lamps have led to extensive efforts to develop a projection lamp of this type. High pressure mercury lamps with short arc lengths, called short arc lamps, are the result of this work. Short arc type lamps have been made experimentally in the United States since World War II, and prior to that in Germany, England and Japan. Research and development in the United States during recent years have resulted in commercially available mercury and mercury-xenon short arc lamps. Improvements in high-current quartz seals, and a newly designed electrode, permitting longer useful

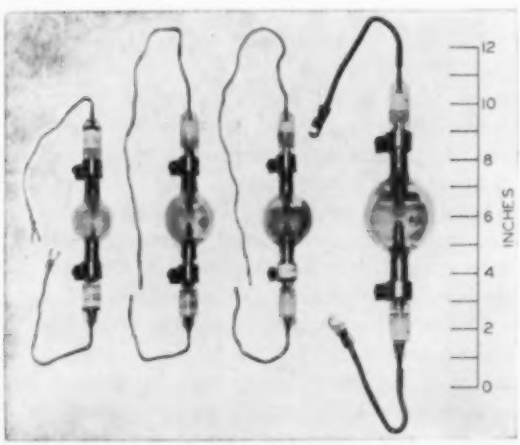


Figure 1. Five types of short arc lamps for a-c operation. From left to right: 800-watt mercury, 1000-watt mercury, 1000-watt mercury-xenon, 2500-watt mercury or mercury-xenon.

AUTHORS: Westinghouse Electric Corp., Bloomfield, N. J.

TABLE I — Approximate Operating Characteristics of Five Types of Mercury and Mercury-Xenon Short Arc Lamps for a-c Operation.

Lamp Type*	SAH 800-C	SAH 1000-A	SAH 2500-A	SAHX 1000-A	Experimental SAHX 2500-A
Watts — Lamp Only (Approx.)	800	1000	2500	1000	2500
Arc Length, mm.	8.5	6.5	10	6.5	10
Brightness, c/sq.mm. (Max.)	180	400	300	400	300
Rated Avg. Life — Vertical Operation at 2 Hours per Start	300	300	200	300	100
Burning Position	Any	Vertical	Any	Vertical	Vertical
	G13	G16	G22	G16 (With PT Coating)	G22
Overall Length (Max.) Excluding Flex. Leads	9½"	9½"	13"	9½"	13"
Starting Requirements	HV Pulse	HV Pulse	HV Pulse	HV Pulse	HV Pulse
Operating Volts (Approx.)	70	65	65	65	65
Current (a-c Amps. Approx.) Starting	15	35	75	32	65
Operating	11.8	18	45	18	45
Operating Vapor Pressure (Atm. Approx.)	10	25	15	30	20
Rated Initial Lumens (at Zero Hours)	40,000	50,000	125,000	50,000	125,000
Time to Full Output Min. (Approx.)	6.5	6.5	6.5	2.5	2.5

*SAH designates short arc mercury.
SAHX designates short arc mercury xenon.

lamp life on alternating current than heretofore obtainable, have made these lamps practical for commercial applications. Five short arc lamps, their design features, operating characteristics, and applications, are described in this paper.

The short arc lamps are shown in Fig. 1. The lamps are made with clear fused quartz bulbs which are spherical in shape and have two diametrically opposite current carrying seal arms. The lamps have flexible electrical connectors and are equipped with cushioned stainless steel mounting collars clamped directly to the clear quartz portion of the seal arms.

The essential technical data for the various lamps are given in Table I. The lamps are designed for alternating current operation, and the values apply to their use on alternating current circuits. However, limited testing on direct current has given good results with the lamp operated in the vertical position and the positive electrical connection made to the lower electrode.

A typical installation of short arc lamps is the ballet of light produced by the four searchlights on top of the Empire State Building (Fig. 2). This installation is the ultimate in remote control in searchlights and could only be made economically possible through the long life and practically maintenance-free 2500-watt lamp.

Undoubtedly, short arc lamps will find their place in many installations which require high brightness from a point source hermetically sealed in a long-life, clean-operating bulb type light source.

(Abstract of Conference Paper No. 14)

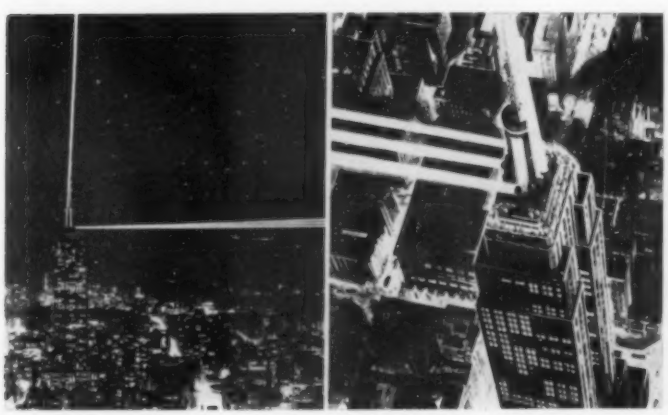


Figure 2. Two views of Empire State Building showing four revolving 60-inch searchlights each using a 2500-watt short arc mercury lamp.

Left to right:
C. W. Pearson
E. A. Linsday
R. T. Dorsey

Characteristics and Applications Of Axial Filament Lamps

A NEW lamp design has been made available in 500-watt, 750-watt, and 1000-watt sizes. These lamps have improved initial light output and lumen maintenance, and give 15 per cent greater mean light output for the same design life than the 500-watt C-9 and 750-watt and 1000-watt C7A lamps. This improvement in performance is obtained by design changes which include the extension of the use of the doubly coiled filament to these lamps and the use of a new axial position of the filament. Fig. 1 illustrates the new construction.

In industrial usage the performance of the axial filament, or CC-8, lamp design is compared with that of the C7A lamp. Field test data covering industrial plant applications show comparable life performance for the two lamps. Light distribution curves of the two lamp types in typical porcelain enamel deep bowl reflectors and semi-diffuse deep aluminum reflectors are presented, and show similar reflector efficiencies and distributions of light, and therefore, the full 15 per cent gain in light is realized.

In commercial lighting, the effect of the new construction is compared in downlights, show window reflectors and floodlights.

The candlepower distribution and efficiency of the downlights and show window reflectors is essentially the same with the new CC-8 construction as with the C-9. Thus, the full advantage of the axial filament lamps can be expected in this type of equipment.

The beam pattern of floodlights with specular reflectors is somewhat different with the CC-8 construction. In general, there is a greater concentration in the center of the beam. This may not be satisfactory for many existing installations, but presents advantages for new ones. Lamps with the C-7A and C-9 construction are still available.

For most applications, the 15 per cent gain in

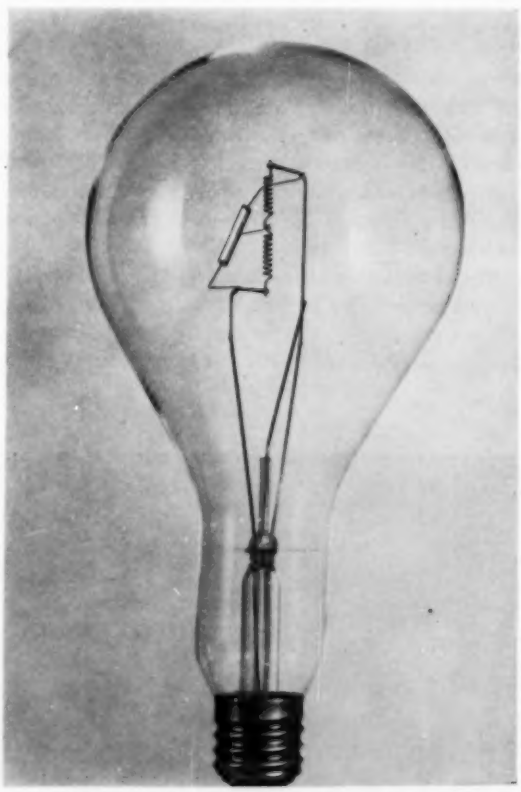


Figure 1. 750-watt lamp — doubly coiled axially mounted filament.

AUTHORS: General Electric Co., Nela Park, Cleveland, Ohio.

light is translatable into a 15 per cent reduction in *total* cost of light — often worth more than the total cost of the lamp.

This new incandescent lamp development offers the user an important increase in efficiency and lumen maintenance. It is apparent that all fields of application will benefit.

In addition, the CC-8 lamp design creates new opportunities for more effective reflector design because: (a) it is a more compact filament form; (b) the filament shape makes possible excellent control — particularly in a plane perpendicular to the axis.

(Abstract of Conference Paper No. 29)

Left to right:
John F. Waymouth
Francis Bitter
Erwin F. Lowry

Factors To Be Considered In the Design of High-Output Fluorescent Lamps

In attempting to increase the output of fluorescent lamps by increasing the power supplied to the lamps, one runs into two main obstacles. These obstacles have previously been thought to be fundamental to the nature of the device. The purpose of this paper is to show that they are not, and to describe means for circumventing them. The first of these is that at high power input the lamps run hot. As a result, the mercury vapor pressure increases to an undesirable extent. The light quanta liberated in the interior of the lamp are then absorbed and re-emitted hundreds of times, and the probability is high that the excitation energy will be converted to heat in an inelastic collision. The optimum vapor pressure in T-12 lamps is known to be about 6 μ, in equilibrium with mercury at about 40 C. We have discovered that it is quite practicable to maintain this optimum pressure in a hot lamp if only a very small part of the surface is kept at the required temperature. Under these conditions mercury diffuses from the hot to the cold portions of the lamp, and, in spite of the

Authors: John F. Waymouth and Erwin F. Lowry, Sylvania Electric Products Inc., Salem, Mass.; Francis Bitter, Massachusetts Institute of Technology, Cambridge, Mass. Work done at the Research Laboratories of Sylvania Electric Products Inc., Salem, Mass.

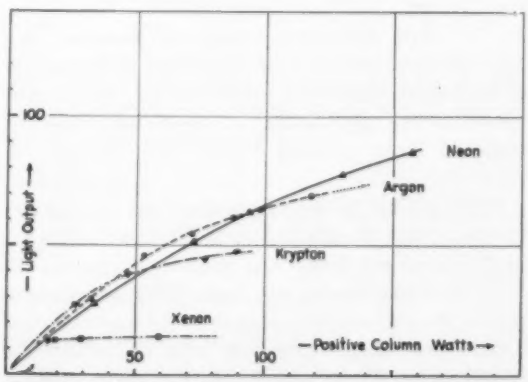


Figure 1. Light output versus power input for 48-inch T-12 lamps filled at two millimeters pressure with the various rare gases.

positive ion current to the entire wall of the lamp, the vapor pressure of the cold spot is maintained throughout.

The second point is that, even if the vapor pressure is kept constant, light output increases with power input only up to a certain limit. Beyond this limit, light output is independent of power input. The experimental facts are summarized in Fig. 1, which shows light output as a function of power input for 48-inch T-12 lamps filled to 2 mm with the various rare gases. It will be seen that, for low power input, of the order of 10 watts/foot, the argon- and krypton-filled lamps are somewhat superior in lumens/watt, but at high power input, of the order of 25 watts/foot, and above, the neon-filled lamps are more efficient. Helium-filled lamps are less efficient through the entire range of power input shown in the illustration, but are more efficient than any others at an even higher power input.

The asymptotic value of light output from these lamps is shown in the paper to be determined by the electron temperature, which depends only slightly on current or power. The electron temperature of the discharge in the presence of neon is shown to be higher than for lamps with other fill gases, thus making possible a brighter lamp.

(Abstract of Conference Paper No. 31)

Left to right:
W. Calvin Gungle
John F. Waymouth
Horace H. Homer

Operating Parameters of High-Output Fluorescent Lamps

THE PRECEDING PAPER has described the basic physical factors to be considered in the design of high-light-output fluorescent lamps. This paper describes the application of these principles to practical lamps yielding "Very High Output" of light.

Table I gives the pertinent electrical and optical characteristics of 48T12 and 96T12 lamps yielding 1600 lumens per foot.

These 1600 lumen per foot VHO lamps give double the highest light output previously obtained from a fluorescent lamp with little or no sacrifice in efficiency. These new results are made possible by fundamental changes in conventional lamps.

TABLE I.
1600 lumens/foot

	48T12	96T12
Light output	6000 lumens	13,000 lumens
Power	100 watts	200 watts
Lamp current	1.25 amp	1.25 amp
Lamp voltage	94 volts	188 volts

One change is the use of neon instead of argon. While argon gives the most efficient operation at conventional loadings, the use of neon provides a more efficient lamp for power input of 100 watts or more in a 48T12 lamp.

A second change has been made to insure that the mercury vapor pressure remains within the desired 6-10 micron range under normal operating conditions. The vapor pressure corresponding to

AUTHORS: Sylvania Electric Products Inc., Salem, Mass.

the increased lamp temperature at higher power inputs in standard lamps is much higher. It has been found that it suffices to maintain a small region at the desired optimum temperature of 40C. The rest of the lamp may be considerably hotter. Various ways of achieving this result have been discovered. The method used in the VHO lamps is to shield a region near the ends of the lamp from the heated electrodes, as shown in Fig. 1.

Here the phosphor has been wiped away, to show the condensed mercury droplets. The desired temperature may be achieved by varying the length of the stem and the number of shields.

(Abstract of Conference Paper No. 32)

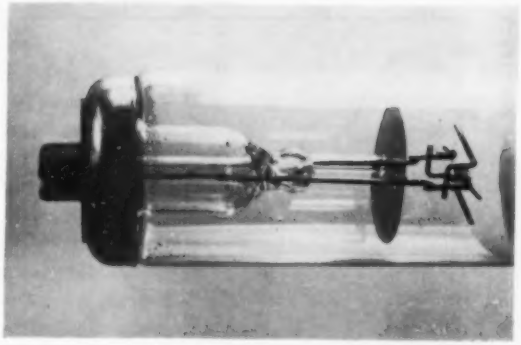


Figure 1. Photograph of end of a 25-watt-per-foot VHO lamp showing condensed mercury.

Phosphors for High Pressure Mercury Vapor Lamps

M. J. B. Thomas K. H. Butler

and J. M. Harris*

THE CLEAR high pressure mercury vapor lamp is now widely used for street lighting and for high-bay industrial lighting even though it is recognized that color rendition is quite unsatisfactory. The visible radiation from this lamp consists almost entirely of the line spectrum of mercury with blue lines at 405 and 436 millimicrons and intense green and yellow lines at 546 and 578 millimicrons. In addition to this visible radiation HPMV lamps, made with a quartz arc tube, emit a large amount of ultraviolet energy which can be converted to visible light by the use of phosphors.

Such phosphors must satisfy the following requirements:

1. They must respond efficiently to a wide range of ultraviolet wavelengths, with response to 313 and 365 mμ being especially important.
2. They must retain high fluorescent efficiency at elevated temperatures.
3. They must be stable at high temperatures to the effects of ultraviolet and to chemically active gases in the lamp envelope.
4. They should have a substantial part of their emission in the long wavelength end of the spectrum if color rendition of reds is to be improved.
5. They should emit near the middle of the visible spectrum, in addition to the red, if loss of lumen output is to be avoided.

Sulfide Phosphors

While sulfide phosphors give good emission in the yellow and red they have poor chemical stability and also are inefficient at high temperatures thus preventing satisfactory use in HPMV lamps.

Manganese Activated Phosphors

The titanate, the arsenate, the germanate, and the antimonate of magnesium can all be activated

AUTHORS: Sylvania Electric Products Inc., Salem, Mass.

*A photograph of Mr. Harris was not available.

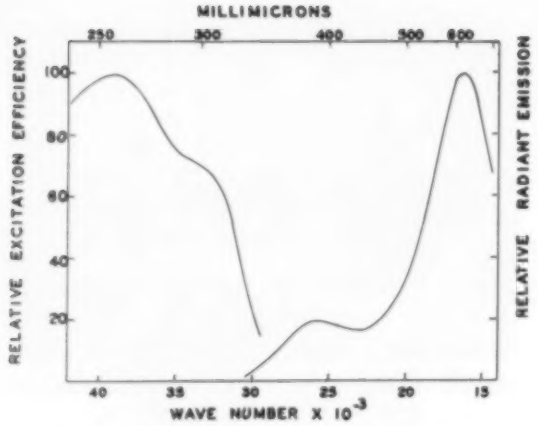


Figure 1. Excitation and emission spectra of tin activated Strontium Zinc Phosphate.

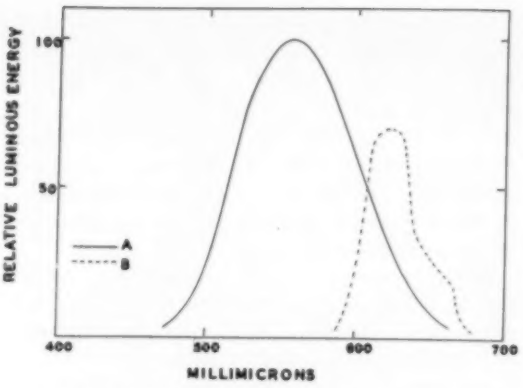


Figure 2. Relative luminous energy distribution of phosphor emission. A Strontium Zinc Phosphate in SH1 lamp, B. Magnesium Germanate in JH1 lamp.

by tetravalent manganese to give strong emission in narrow bands in the deep red (640 to 680 millimicrons). While these phosphors satisfy, with some variation, most of the requirements imposed by the HPMV lamp the visual effectiveness of the deep red emission is so poor that the lumens contributed by the light from the phosphor are not sufficient to overcome the loss of lumens caused by partial absorption of the visible mercury lines by the coating. Nevertheless the germanate phosphor has been widely used for color correction in the past even though the lamp ratings were 5 to 10 per cent below those of the corresponding clear lamps.

A triple silicate phosphor has also been described in the literature but has not been put into use, possibly because of the poor chemical stability of the combination of cerium with divalent manganese with which it is activated.

Phosphate Phosphors

A recently discovered phosphor, strontium-zinc orthophosphate activated by stannous tin, has been found to have definite advantages over the materials previously described. It responds efficiently to a wide region of ultraviolet up to 320 mμ with a broad emission band in the orange-red, as shown in Fig. 1. It is non-toxic and potentially low in cost. In addition the red output is high while the peak efficiency lies in the range of operating temperature of the usual HPMV lamps.

Lamp Performance

HPMV lamps using a strontium-zinc orthophosphate phosphor coating have efficiencies 10 to 20 per cent above that of the corresponding clear lamps since the phosphor converts the shorter ultraviolet into visually effective light. Fig. 2 shows the relative *luminous* energy for germanate and for phosphate phosphors in 400-watt HPMV lamps.

Colored Mercury Lamps

The broad fluorescent emission curve of the strontium-zinc phosphate phosphor allows the production of high intensity sources of colored light by using a filter coat on the outer lamp jacket. The best of these gives a golden yellow light which is in striking contrast to the silver white light of the lamp using the phosphor without a filter coat.

Applications

The improved color rendition and higher lumen output of the lamp made with the new phosphate phosphor opens new fields for lighting by mercury lamps since it is no longer necessary to sacrifice efficiency for color. Applications in high bay industrial light, residential street lighting, and parking lot lighting are obvious.

The golden yellow light of the filter coated lamps presents a new opportunity to safety engineers as it gives a unique color of light with high efficiency.

(Abstract of Conference Paper No. 30)

The Efficiency of Electroluminescence

Willi Lehmann

To the two common methods of producing light from electrical energy, incandescence and gas discharge, a third method, electroluminescence, is on the threshold of development. Electroluminescence is the emission of light by excitation of substances by the sole action of an electric field. In the most usual form, an alternating electric field is applied to a layer of a powdered phosphor embedded in a suitable dielectric material between two electrodes in an electroluminescent cell. The development of electroluminescence during recent years has yielded such remarkable results that a future practical application seems to be likely.

Among the properties describing the qualifications of an electroluminescent lamp for practical illumination purposes, the luminous efficiency is one of the most important. Extended measurements, therefore, have been made concerning the luminous efficiency of electroluminescence and its dependence on several parameters such as voltage, frequency, etc. Equations describing the dependence of the efficiency on voltage and frequency are developed from dielectric measurements and compared with experimental results. The main results are:

(a) When the applied voltage V increases, the emitted light intensity L also increases up to the highest voltages used, but the efficiency η increases up to a maximum in the region of moderate voltages. This peak efficiency is always coincident with the point where $L \propto V^4$ (Fig. 1) independent of phosphor and frequency.

(b) A comparison of efficiency η and light emission L of two sulfide type phosphors (similar emission spectra) under similar excitation conditions gives the relation $\eta_1/\eta_2 = (L_1/L_2)^{1/4}$. Hence, those phosphors with highest electroluminescent brightnesses are automatically also those with highest efficiencies, and vice versa.

(c) Varied frequency (but constant voltage amplitude) causes for almost all phosphors an efficiency peak between about 500-5000 cps (Fig. 2). This peak, however, is more pronounced for some phosphors while other phosphors show a luminous efficiency nearly independent of frequency within wide ranges.

(d) The highest efficiency observed so far under best excitation conditions is approximately 12 lumens/watt for the phosphor itself and 8-9 lumens/watt for a complete electroluminescent cell containing this phosphor embedded in castor oil.

(Abstract of Conference Paper No. 13)

Author: Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J.

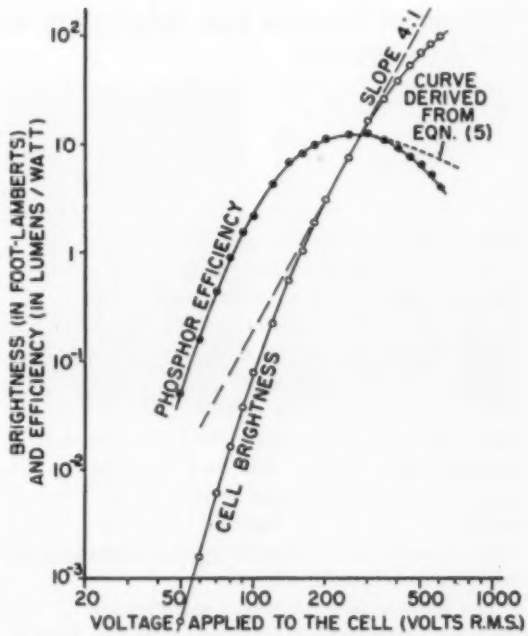


Figure 1. Typical voltage dependence of brightness and efficiency of electroluminescence. Phosphor: green-emitting Zn S-Cu, Cl. Frequency: 50 cps.

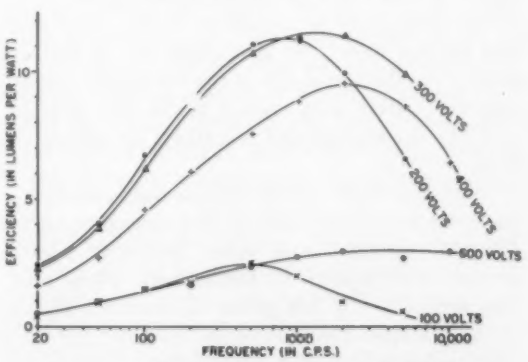


Figure 2. Frequency dependence of efficiency. Phosphor: green-emitting Zn S-Cu, Cl.

Abstracts of
I.E.S. Conference Papers on

Street Lighting

Discomfort Glare at Low Adaptation Levels—II Off-Axis Sources

Russell C. Putnam

Willard F. Gillmore, Jr.

VISUAL COMFORT in a street or highway installation interests the lighting engineer as well as efficiency, distribution, pavement brightness, visibility and the other factors in which he is concerned. One of the techniques for the measuring of visual comfort is the method of experimental determination of the brightness that is on the borderline between visual comfort and discomfort under different conditions. The BCD technique of Luckiesh and Guth[1,2] has been applied in this paper to a study of light sources of visual sizes applicable to street lighting conditions when viewed above the horizontal line of sight against low brightness backgrounds.

The apparatus used was a modification of that used by Putnam and Faucett[3] with the flashing sequence arranged so that a comparison source on the horizontal line of vision and a variable test source at some angle above the horizontal were presented alternately to the observer. The four variable factors were: (1) the brightness of the test source, (2) the visual size of the test source, (3) its relative position with respect to the line of sight, and (4) the background brightness or adaptation level.

A series of BCD determinations was made by the observers for a source size of .0001 steradian, on the direct horizontal line of vision, and with a background brightness of .01 footlambert. These readings served to key this group of observers to that of the previous investigation and to determine their relationship to a normal distribution.

AUTHORS: Case Institute of Technology, Cleveland, Ohio.

In the next part of the investigation, the source sizes and the background brightness remained the same. The observer was told to look at the comparison source on the direct horizontal line of vision (held at 315 footlamberts) and adjust the brightness of the test source located above the comparison source to a value which he considered to give a sensation equal to the comparison source. Each observer made a series of BCD determinations for each of the following angles above the horizontal: 7½°, 15°, 20°, and 30°. The geometric mean of their results showed that the higher the light source is above the line of vision the higher the brightness of the source can be before it becomes uncomfortable.

The size of the test source was then varied while the angle above the horizontal remained fixed at 20°. The background brightness was maintained at .01 footlambert and the comparison source of .0001 steradian was again set at 315 footlamberts. BCD determinations were taken by each observer for

each of the following solid angle sizes of the test source: .0011, .0001, .00001 and .000001 steradian. The geometric mean values of the readings show that they follow Ricco's law closely, which states in its simplest form that for very small light sources, the product of the area of the source and its brightness is a constant for equal visual sensation.

The information given here will add to the large amount of data which will eventually be available that will make possible the design of comfortable lighting installations for street and highway.

1. Luckiesh, M., and Guth, S. K.: "Brightness in Visual Field at Borderline between Comfort and Discomfort," ILLUMINATING ENGINEER, Vol. XLIV, No. 11 (November 1949).
2. Guth, S. K.: "Comfortable Brightness Relationships for Critical and Casual Seeing," ILLUMINATING ENGINEERING, Vol. XLVI, No. 2 (February 1951).
3. Putnam, Russell C., and Faucett, Robert E.: "The Threshold of Discomfort Glare at Low Adaptation Levels," ILLUMINATING ENGINEERING, Vol. XLVI, No. 10 (October 1951).

(Abstract of Conference Paper No. 28)

Left to right:
John R. Brass
Harold Skootsky
Gilbert A. Trosper

A New Approach to Highway Tunnel Lighting

THE ILLUMINATION of tunnels has progressed from practically no lighting to quite high levels in today's high speed, high volume bores. As new light sources were developed, engineers tried them out and generally each new installation provided better visibility than the last.

We believe that much improvement in daytime entrance lighting is still required and also that many recent projects provide more light than necessary at night.

Daytime lighting should provide for the following: (1) Satisfactory visibility into the tunnel from the outside, (2) adequate visibility almost instantly upon entering, (3) satisfactory visibility through the central portion of the tunnel. Only the first condition presents a difficult problem.

AUTHORS: Engineers, California State Highway Dept., San Francisco, Calif.; and Street Lighting Engineer, Pacific Gas & Electric Co., San Francisco, Calif., respectively.

The visibility curve which is based on observation will serve to illustrate that adaptation lighting stages are not necessary for drivers after they have entered a fairly well lighted tunnel. The curve also shows that visibility of obstacles located about 75 to 250 feet within the entrance of conventionally lighted tunnels is practically nil *before* the motorist enters the tunnel. However, visibility of these same obstacles will be fair to good almost instantaneously after entering a tunnel with the light levels indicated.

Tests indicate that a haze composed of dust and vehicle exhaust, in direct sunlight outside tunnel *entrances*, produces a veiling brightness super-imposed on the entrance, of between 50 and 90 footlamberts, as observed 200 feet from the entrance. See tunnel entrance sketch. The veiling brightness varies directly with the distance between the driver

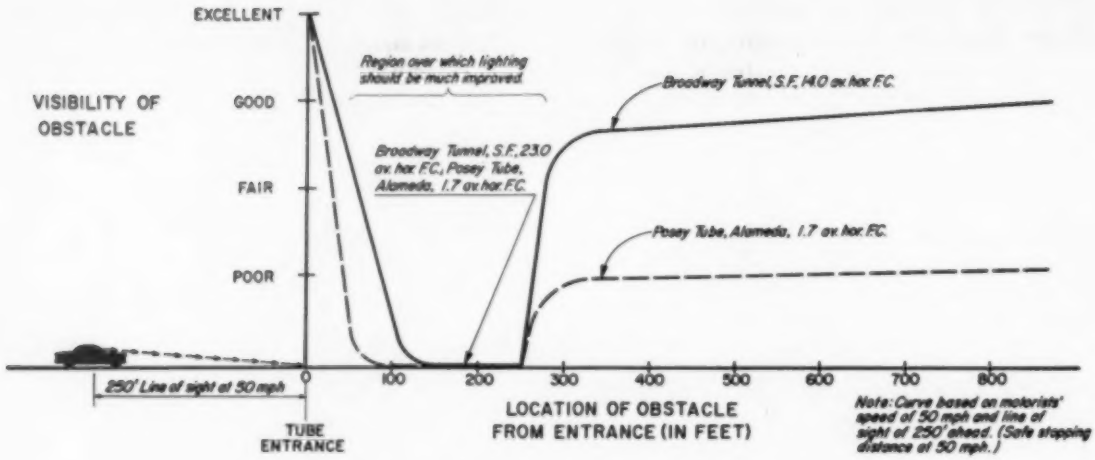

EXCELLENT
VISIBILITY OF OBSTACLE
GOOD
FAIR
POOR
Region over which lighting should be much improved
Broadway Tunnel, S.F., 14.0 cv. hor. F.C.
Broadway Tunnel, S.F., 23.0 cv. hor. F.C., Posey Tube, Alameda, 1.7 cv. hor. F.C.
Posey Tube, Alameda, 1.7 cv. hor. F.C.
250' Line of sight at 50 mph
0
100
200
300
400
500
600
700
800
TUBE ENTRANCE
LOCATION OF OBSTACLE FROM ENTRANCE (IN FEET)
Note: Curve based on motorists' speed of 50 mph and line of sight of 250' ahead. (Safe stopping distance at 50 mph.)

Figure 1. Visibility of obstacles (other vehicles) within typical tunnel and tube.

and the tunnel and with the concentration of dust and exhaust material in the air. The above factor and the possible existence of relatively poor eyes, dashboard and hood reflections, dirty windshields and bright vehicles ahead are of much greater importance than the brightness of portal surroundings.

Since it is impossible, for all practical purposes, to control the above mentioned factors, as well as the roadway reflecting surfaces, every effort should be made to use tunnel ceilings and walls to silhouette objects and vehicles ahead. Tests indicate that an average wall and ceiling brightness of from 30 to 60 footlamberts within a 300-foot entrance section will be satisfactory. If this is accomplished, the illumination on the roadway will be more than adequate. Considering the above, fixtures providing direct lighting on the roadway would be undesirable.

The determination of illumination required for the *central zone* of a long tunnel or tube becomes more a problem of providing adequate driver visibility and relieving driver apprehension than of increasing driver safety. It is therefore necessary to rely on observations and judgment to determine proper day-time and night-time lighting. The following conclusions were reached for central zone lighting:

1. Visibility was judged very satisfactory when vehicles were clearly seen in silhouette against walls and ceilings.

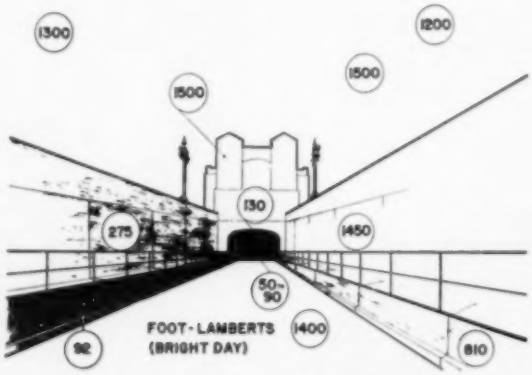


Figure 2. View 200 feet from Southwest entrance of Posey Tube, Alameda.

2. A night-time wall brightness of about ⅓ footlambert and day-time wall brightness of about 6 footlamberts are recommended.

3. Night-time entrance lighting should be the same as that recommended for the central zone.

4. Roadway approach lighting will depend upon exterior roadway conditions, each requiring special study.

The authors recommend continued research and would like to stress the point that many careful observations under widely varying conditions should be made.

(Abstract of Conference Paper No. 25)

Some Factors Influencing the Night-Visibility of Roadway Obstacles

D. M. Finch

THE PAPER describes work done upon the problem of evaluation of visibility under roadway conditions and gives some data for visibility under uniform and non-uniform pavement brightness patterns using several types of targets. A contrast-threshold type instrument is described which is suitable for night-time use under roadway conditions for background brightness of 0.01 to 1.0 foot-lambert. A "visibility index" is discussed which is based upon the instrument readings and indicates the visual conditions in terms of an equivalent gray disc upon a uniform gray background.

The outdoor full-scale street lighting laboratory is described together with the lighting systems to obtain the uniform and non-uniform pavement brightness patterns. Visibility indices for the two pavement brightness patterns are tabulated and indicate the importance of shape of target as well as type of lighting system and uniformity of pavement brightness in developing the visual environment.

The directional effect of lighting is shown by the use of three-dimensional instead of two-dimensional targets.

For extremely non-uniform brightness patterns it is possible to lose a small target in the dark areas.

For uniform brightness patterns it is possible to lose a two-dimensional target at certain locations where the target brightness matches the background brightness.

Tall narrow targets do not bring out the differences between brightness patterns because there is generally some area on the target wherein a supra-threshold contrast is developed.

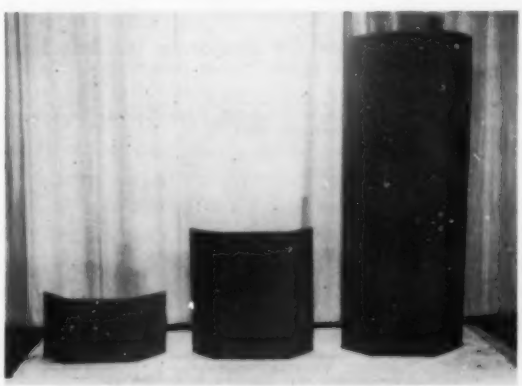
No single target or evaluation procedure has been agreed upon for general use, since there are so many different visual situations that develop in the night-time roadway scene.

(Abstract of Conference Paper No. 27)

AUTHOR: School of Electrical Engineering, University of California, Berkeley, Calif.

Figure 1. Daytime scene of outdoor Street Lighting Laboratory at University of California Engineering Field Station, Richmond, Calif.

Figure 2. Roadway targets: (above) 18-inch plane disc, partial octagonal-section, full octagonal-section targets; (right) 3-sided vertical plane targets suggested by Illuminating Engineering Research Institute Committee.



George A. Nagel

A Highway Lighting Test Installation

THIS PAPER presents information and public opinion data pertinent to the problem of lighting turnpikes to be pleasant and attractive as well as safe for night use.

It incorporates the results of public opinion sampling, instrumentation, and photographic data taken with the camera in front of the luminaire and behind the luminaire to show the difference in discernment with equal exposure time, using the same film under controlled processing.

The paper describes the test installation made by the State of Connecticut in the Town of Old Lyme and includes pictures of the installation as well as graphs showing the results of the instrumentation. Graphs are also included showing relative effective visibility, fluctuating brightness, disability veiling brightness, and discomfort glare.

The subject is approached from the view-point of the application engineer utilizing information available on the subject, and stresses the lack of data and procedures for use in connection with turnpike lighting. Different approaches were used, such as measurements by means of a Spectro-Brightness Spot Meter; photographic sequence data; and a device for measuring incident light intensity.

AUTHOR: Associate Highway Engineer, State Highway Department, State of Connecticut, Hartford, Conn.

Figure 1. Fluorescent luminaires installed on test lighting strip, Old Lyme, Conn. Official photograph, Connecticut State Highway Department.

Figure 2. Conventional mercury luminaires installed on the test strip at Old Lyme, Conn. Official photograph, Connecticut State Highway Department.

Several conclusions are drawn as a result of the highway test lighting installation and are offered for consideration in connection with turnpike lighting design.

(Abstract of Conference Paper No. 26)

Abstracts of
I.E.S. Conference Papers on

Lighting Applications

Some Factors Influencing the Design of Exposed Lamp Signs for Daytime Effectiveness

A. L. Hart

THERE is great interest in exposed lamp signs that use high-candlepower sources and are designed for daytime effectiveness as well as night. This paper presents some observations and data that should assist in this design.

In order to develop rules for the pre-determination of letter proportions, lamp spacing and lamp wattage for signs, it is desirable to know what effect factors such as lamp candlepower, total sign candlepower, viewing distance and background brightness have on the apparent size of a light source when viewed at a distance. This was done for typical sign lamps, viewed at night, by C. A. Atherton in the early 1920's. These data were fundamental and are the basis for present sign design rules published in the *IES Lighting Handbook* and elsewhere.

AUTHOR: General Electric Co., Nela Park, Cleveland, Ohio.

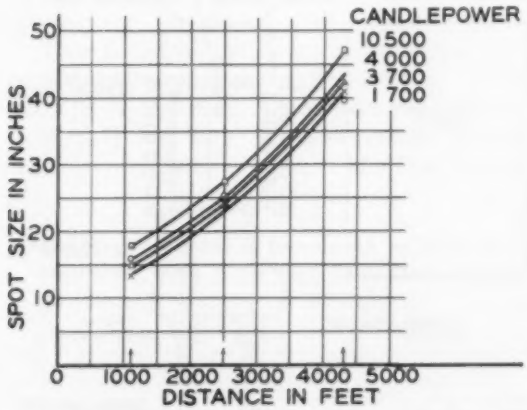


Figure 1. Spot size vs. distance. Four lamps of different candlepower. Clear weather, very light ground haze, background sky brightness—3100 to 4900 footlamberts.

With the use of a device which varied the spacing between lamps, and an eight-foot adjustable letter "E," observations were made of PAR-38 lamps—25-watt flood, 75-watt flood and spot, and 150-watt flood and spot — at viewing distances of 1100, 2500, and 4300 feet. The effect of candlepower and distance is shown in the graph which indicates that apparent spot size is primarily a function of distance and to a lesser extent, a function of candlepower. The candlepower needed for advertising effectiveness was observed and reported.

It was found that under daytime conditions, variation in background sky brightness down to 500 footlamberts had very little effect on apparent spot size. Studies were made of the transition period at dusk where the candlepower necessary during the day becomes excessive and low voltage operation is not yet effective.

(Abstract of Conference Paper No. 6)

A Uniform Light Source Excited by Radio Frequency

Sanford C. Peek

The Radio Frequency Lamp, or RF lamp, produces light through the induction heating by radio frequency power of a solid disk of highly refractory metal. The light source is small, bright and uniform. The lamp is specifically designed to be used in equipment and processes requiring a rather narrow pencil of light rays, such as projectors, printers, microscopy and color picture tube processing. Fig. 1 is a photograph of the RF Lamp and Power Supply.

The RF Lamp consists of a five-sixteenth inch diameter tantalum carbide disc, called a target, surrounded by a silver-plated copper cylinder, called a concentrator, which concentrates the magnetic field at the target. The induction heating coil of a high frequency oscillator contained in the Power Supply is placed around the lamp and closely coupled with the concentrator. Therefore, in effect, the target becomes the final sink for most of the radio frequency power generated by the oscillator. Fig. 2 is a schematic drawing of the RF Lamp.

The Power Supply consists of a power supply and an oscillator in two separate cabinets. Cables connect the power supply to the oscillator and transmission lines connect the oscillator to the induction heating coil of the RF Lamp. The power supply is a three-phase, full-wave rectifier with associated control components. The oscillator consists of a pair of 833A tubes in a push-pull shunt fed oscillator circuit.

The length of life and amount of brightness of the RF Lamp is graphically illustrated in Fig. 3. A 750-watt biplane projection lamp has an average brightness of about 21,000 candles per square inch. It can easily be seen from Fig. 3 that both longer

Author: Sylvania Electric Products Inc., Salem, Mass.

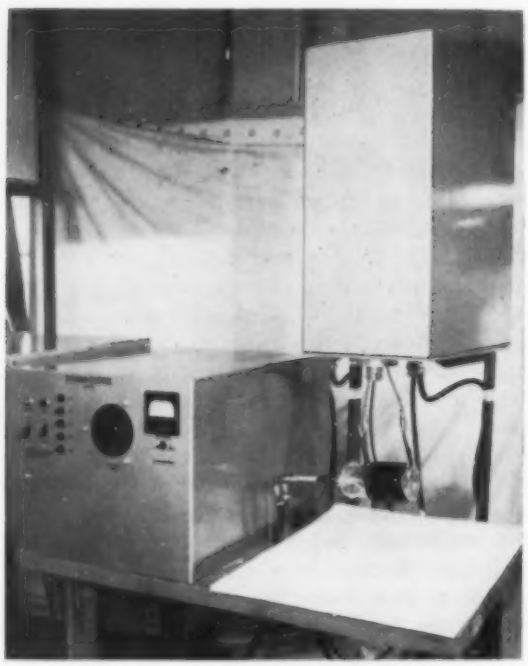


Figure 1. The RF Lamp and Power Supply.

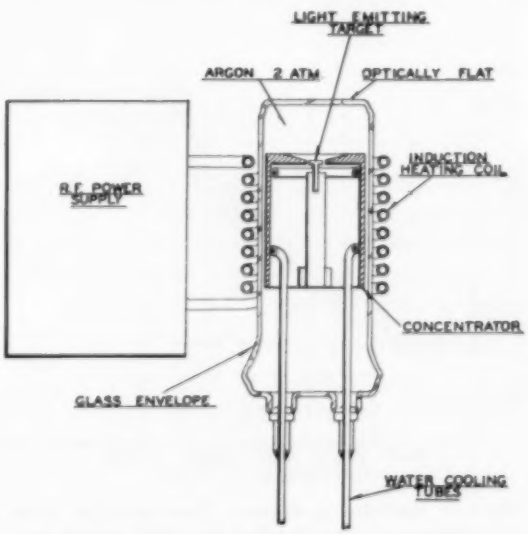


Figure 2. Schematic drawing of the RF Lamp.

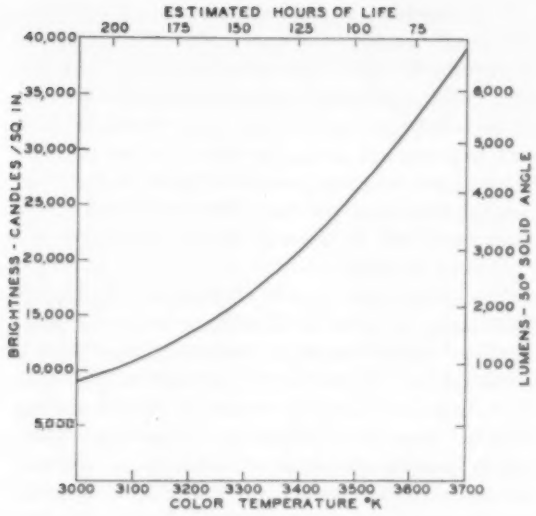


Figure 3. RF Lamp life and brightness.

life and higher brightness can be obtained from the RF Lamp than from a biplane projection lamp.

The power supply has been certified by the Federal Communications Commission. It has been in use for over five years with no interference reported.

The advantages of the RF Lamp can be fully realized in processes and equipment such as infrared spectrometers, sixteen millimeter movie projectors and in the graphic arts industry for color reproduction. The RF Lamp is well adapted for use in the photographic process involved in manufacturing color television picture tubes. It has been found that the use of the RF Lamp in this process reduces the cost and increases the production rate of color television tubes. The RF Lamp is now being used by several of the major studios for moving picture film printing.

(Abstract of Conference Paper No. 8)

Interior Lighting With High-Output Fluorescent Lamps

W. H. Johnson

AVAILABILITY of the high-output rapid-start lamp faces the illuminating engineer with the problem of luminaires in which to use it. The purpose of this paper is to investigate the performance and economic suitability of adapting current luminaire designs for use with this new rapid-start T-12 lamp.

Three industrial and three commercial type luminaires, ordinarily used with the 8-foot slimline lamp, were converted for use with the 850 ma 8-foot rapid-start lamp. When suspension mounted, all units were found to conform with Underwriters' Standards regarding maximum ballast temperature. Photometric distribution curves were next run for each unit. Performance comparisons are then made between the modified units using the high-output rapid-start lamp and the standard unit using the 8-foot slimline lamp.

TABLE I — Efficiency Comparison of Industrial Luminaires Using Slimline or Rapid Start Lamps.

Luminaire Classification	Lamp	Luminaire Efficiency
Totally Direct	Slimline	79.6%
	Rapid-Start	78.7%
Ventilated 10% Upward	Slimline	85.5%
	Rapid-Start	84.8%
Slotted 20% Upward	Slimline	86.7%
	Rapid-Start	87.9%

Table I is a comparison of the efficiency of the different classification industrial luminaires and compares the same type luminaire using either the 8-foot slimline lamp or the 8-foot high-output rapid-start lamp. The efficiency comparison, between similar luminaires, is very close and gives no

AUTHOR: Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio.

TABLE II — Efficiency Comparison of Commercial Luminaires Using Slimline or Rapid Start Lamps.

Luminaire Classification	Lamp	Luminaire Efficiency
Direct-Indirect	Slimline	86.3%
	Rapid-Start	83.9%
Semi-Indirect	Slimline	74.6%
	Rapid-Start	67.3%
Direct (Bare Lamp)	Slimline	88.5%
	Rapid-Start	85.1%

indication of luminaire performance change when rapid-start lamps are substituted for slimline lamps. Subsequent economic studies favor the new 850 ma lamp over other fluorescent lamps in initial cost, operating cost, and annual cost.

Table II compares the efficiencies of several commercial luminaires using the 8-foot slimline lamp and the 850 ma 8-foot rapid-start lamp. The difference between the efficiencies of similar units here, compared to those in Table I for industrial luminaires, is considerably greater. Commercial luminaire design tends to restrict and reduce air circulation about lamps and as a result the heavily loaded rapid-start lamp operates above optimum bulb wall temperature and suffers a decrease in light output. This is particularly evident with the semi-indirect luminaire with a solid plastic bottom, where efficiency drops 7 per cent compared to a similar luminaire using the 425 ma 8-foot slimline lamp. Economic comparisons between similar commercial luminaires still favor the high-output rapid-start lamp but to a lesser degree than with the industrial luminaires.

The integration of the high-output rapid-start T-12 lamp for interior lighting seems most practical and economical for industrial lighting. Industrial lighting allows the use of high-output light sources because of the relatively high mounting heights commonly available. Commercial luminaires present problems of redesign to increase efficiency. Better shielding of this lamp in commercial luminaires is necessary before it will meet the stringent quality restrictions limiting brightness, particularly those restrictions in the school and office lighting fields.

(Abstract of Conference Paper No. 5)

Flashing Characteristics Of Fluorescent Lamps

J. H. Campbell

D. D. Kershaw

ANOTHER of the few remaining limitations in the application of hot cathode fluorescent lamps has been removed by the development of the flashing system.

This paper describes the flashing characteristics of fluorescent lamps and circuits along with corresponding life test results. Various circuits developed for use in flashing service are outlined and related to lamp requirements and ballast specifications.

The inherent ability of the ordinary filament lamp to take any on-off cycle without seriously impairing its rated life provided a natural light source for the sign manufacturer. Until recently, signs containing fluorescent lamps were economically feasible only when designed for on-off periods of several hours.

AUTHORS: General Electric Co., Nela Park, Cleveland, Ohio.

Tests by F. J. Vorlander[1] in 1947 indicated the possibility of frequent flashing if certain critical limits of preheat and starting voltage were maintained. Development[2,3] of the first fluorescent dimming systems provided the basis for a practical flashing ballast by utilizing the control lead of the ballast in a switching circuit. This permits continuous application of preheat current to the lamp

electrodes, thus eliminating the normal delay in starting. Reliable starting has been obtained with this circuit on a flashing cycle of one-half second.

A number of interesting facts with regard to the behavior of rapid start cathodes under flashing conditions were revealed during the starting tests. These tests were made to determine the optimum cathode preheat voltage range for satisfactory lamp life. Fig. 1 shows an example of the effect of preheat voltage on emission material of a 40-watt rapid start cathode. The cathode shown in the upper photo was operated at 4.5 volts, whereas the cathode in the lower photo was operated at 3.5 volts (standard cathode voltage for conventional operation). The lamp had been flashed at a rate of one second on and one second off for a period of three hours. At the end of this time a noticeable distortion in lamp current waveshape was observed during one-half of the cycle. This was due to the loss of barium and contamination of the cathode surface of the lower cathode. Contamination increases the cathode fall causing a progressive destruction of the emission material by increased ion bombardment.

Through the preceding test and others, the many variables involved in lamp life tests were held to a minimum.

To determine flashing life, 32 individual life tests consisting of ten lamps each were conducted. Variables fell into three general groups: (1) cathode voltage, (2) cyclic flashing rate, and (3) ballast circuits.

Results to date of the most significant of these tests are shown in Table I. One test now well over thirty million starts is a strong indication that satisfactory lamp life can be obtained for all flashing applications. The tests in which cathode voltage was the only variable indicated that best performance will be obtained with a design center of 4.75 plus or minus 0.25 volt for the low current rapid start lamp and 4.05 plus or minus 0.25 volt for the high current rapid start lamp.

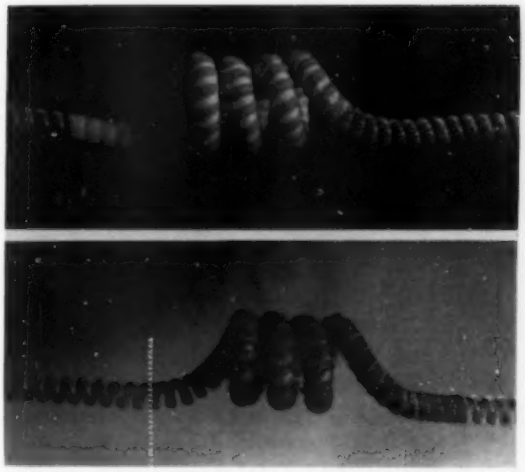


Figure 1. Cathodes taken from the same 40-watt rapid-start lamp operated for three hours on a one second on, one second off flashing cycle. (Upper photo) Shows normal condition of cathode when operated at 4.5 volts preheat. (Lower photo) Shows contamination of cathode due to marginal operation on 3.5 volts.

The foregoing test data are reported to illustrate lamp and circuit requirements and to serve as a guide to ballast manufacturers and users of fluorescent flashing systems. Future developments in lamps and circuits will undoubtedly provide even more flexibility and additional advantages. A watchful eye will be kept on possibilities for improving this new lighting tool.

1. Vorlander, F. J.: "Repetitive Flashing of Hot Cathode Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. XLIII, No. 9 (September 1947).
2. Campbell, J. H.; Schultz, H. E.; and Abbott, W. H.: "Dimming Hot Cathode Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. XLIX, No. 1 (January 1954).
3. Kershaw, D. D.: "Variable-Reactance Dimming Control for Fluorescent Lamps," *Electrical Engineering*, Vol. 74, No. 5 (May 1955).

(Abstract of Conference Paper No. 21A)

TABLE I — Flashing Life Test Data.

Test No.	1	2	3	4	5	6	7	8
Lamp Type	40-w R.S.	40-w R.S.	40-w R.S.	40-w R.S.	40-w R.S.	40-w R.S.	48" R.S.	72" R.S
Ballast Type	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5C	Fig. 5C
Preheat Voltage	3.5	4.0	4.5	4.5	4.5	6.5	4.1	4.1
Flashing Cycle (sec. on & off)	1 & 1	1 & 1	1 & 1	½ & ½	4 & 1	1 & 1	1 & 1	1 & 1
No. of Flashes	86,000 to 250,000	1,411,000	15,300,000	30,600,000	4,040,000	1,710,000	8,771,000	8,771,000
Hrs. of "On" Time	14	784	4,250	4,250	4,492	475	2,436	2,436
Total Cycle Hrs.	28	1,568	8,500	8,500	5,615	950	4,873	4,873
Avg. End Discoloration	Poor	Fair	Good	Good	Good	Poor	Good	Good
Avg. Cathode Condition	Poor	Fair	Good	Good	Good	Good	Good	Good
No. of Failures	10 out of 10	1 out of 10	None	None	None	None	None	None
Status	Completed	Still in Progress	Still in Progress	Still in Progress	Still in Progress	Still in Progress	Still in Progress	Still in Progress

Flashing Applications Of Fluorescent Lamps

R. W. Bunner

R. T. Dorsey

In the last few years fluorescent lamps have come into wide use in the electrical advertising field. Their high efficiency in producing white, colored, and black light; long life (7500 hours for most types); ready availability; a wide variety of lengths; and high light output per foot are among the reasons for their popularity. Moreover, a linear source makes it easy to get uniform brightness of luminous elements and is desirable for lighting poster panels and some forms of building floodlighting, as well as silhouette sign and store front lighting.

As with any widely used electrical advertising technique, distinctiveness in shape, pattern, size, brightness, color, and animation is needed to enable one sign to stand out from its neighbors. The development of flashing of rapid-start lamps has made practical a whole new range of effects. Spectacular changes in pattern, emphasis, texture, etc., can be produced by flashing from one color circuit to another. This effect is illustrated by the attached drawing. When the blue lamps are on, the emblem is most prominent; when the gold lamps are on, the letters "IES" are most prominent; and when both circuits are on, the mixture of light is nearly white, giving colors their normal appearance. Rapid and continuing transition between these phases makes an attractive display.

New ballasts have been designed which operate rapid-start fluorescent lamps in flashing service. Flashing applications using standard ballasts and line interruption will not provide satisfactory lamp life. The new ballasts provide continuous heating of the cathodes. The lamp current only, is interrupted to provide the flashing effect. Ballasts are designed for single and two-lamp flashing operation of F40T12RS, F24T12RS, F36T12RS, F48-T12RS, F64T12RS, F72T12RS, and F96T12RS lamps. Typical lamp ratings are 430 ma, 800 ma, 1.00 amp.

Suitable external flashers are used to provide on-off, or step flashing sequences.

Underwriters' Laboratories listing for flashing rapid-start has been obtained for suitability of combinations. The ballasts, to produce good service and long life, are designed to meet normal industry standards for light output and heating.

Field experience on lamps, circuits, and ballasts for flashing rapid-start lamps is being gained. New ballast circuits are being investigated to improve this market — for example, the single ballast for independent flashing of three lamps. The great appeal provided by flashing of fluorescent lamps indicates a new and exciting phase of the electrical advertising field.

(Abstract of Conference Paper No. 21B)

AUTHORS: Ballast Engineering Section, Ballast Dept., General Electric Co., Danville, Ill.; and Application Engineering, Large Lamp Dept., General Electric Co., Nela Park, Cleveland, Ohio, respectively.

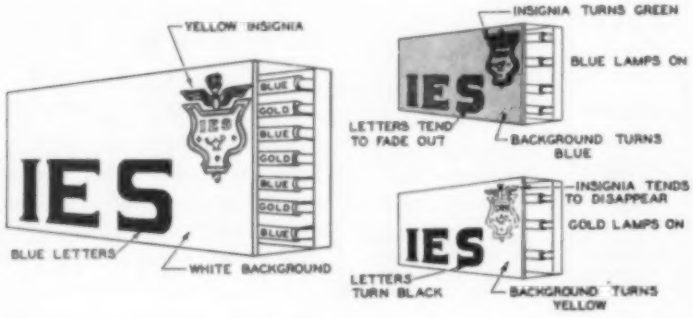


Figure 1. Spectacular changes in pattern, emphasis, texture, etc. can be produced by flashing from one color circuit to another. In this case, when the blue lamps are on, the emblem is most prominent; when the gold lamps are on, the letters IES are most prominent; and when both circuits are on, the mixture of light is normally white, giving colors their normal appearance.

Mercury Floodlighting— Its Advantages and Limitations

James R. Bale

THE RAPID advancements that have been made in the field of mercury lighting in recent years have stimulated considerable interest in the application of the mercury source to floodlighting. The 7000 hours life, at which the greater portion of the mercury lamps are now rated, and the high lumens per watt efficiency of the mercury source are particularly appealing features in this era of high labor and equipmnt costs.

Nearly all of the floodlights offered today for use with the mercury source are units that were designed for the filament lamp, or modifications of the same. Since the filament source is a much closer approximation of the ideal point source than the 2- to 6-inch mercury arc it is obvious that the problems of light control with the mercury source are much more complex than with a filament lamp. Beam spread, beam candlepower, and beam efficiency are all affected by the size of the mercury lamp.

Beam Spread — A full range of IES beam types are attainable with the clear mercury lamp. With the fluorescent mercury lamp, however, the beam spreads are limited primarily to the wide distributions: IES types 5 and 6.

Beam Candlepower — Average maximum candlepower values of 100,000 candlepower and more can be obtained with a clear mercury lamp. The combination of lamp, reflector, and lens required, however, generally produces a highly concentrated peak in the candlepower distribution; curve a, Fig. 1; with the result that the maximum candlepower may be 2 to 3½ times the average maximum candlepower. The effect of this type of distribution on the degree of uniformity obtainable is illustrated in Fig. 2. The high ratio of maximum to average maximum candlepower can be substantially reduced by the use of a diffusing lens or an etched reflector; curve d, Fig. 1; but a simultaneous sharp decrease in available peak candlepower results.

In floodlights operating the clear mercury lamp

AUTHOR: Westinghouse Electric Corp., Cleveland, Ohio.

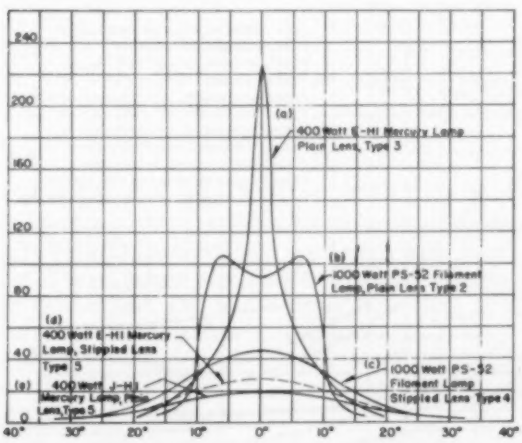


Figure 1. Typical horizontal candlepower distribution curves for a general purpose floodlight with a specular reflector.

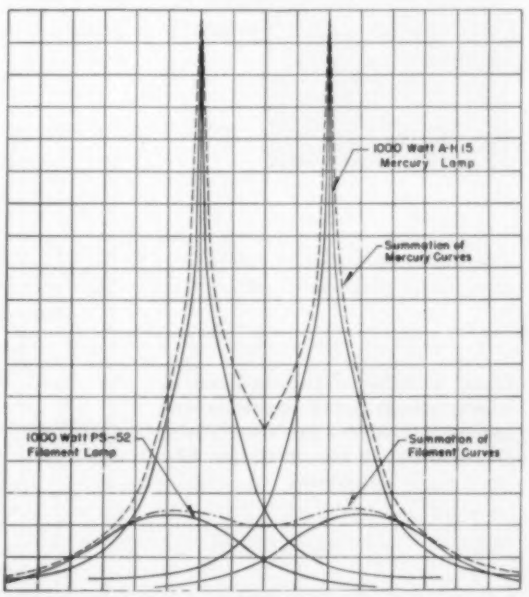


Figure 2. Comparison of uniformity obtainable with typical filament and mercury floodlights with plain lens and specular reflector. Both units are NEMA-IES Type 5 spaced to obtain average maximum candlepower at midpoint between aiming locations.

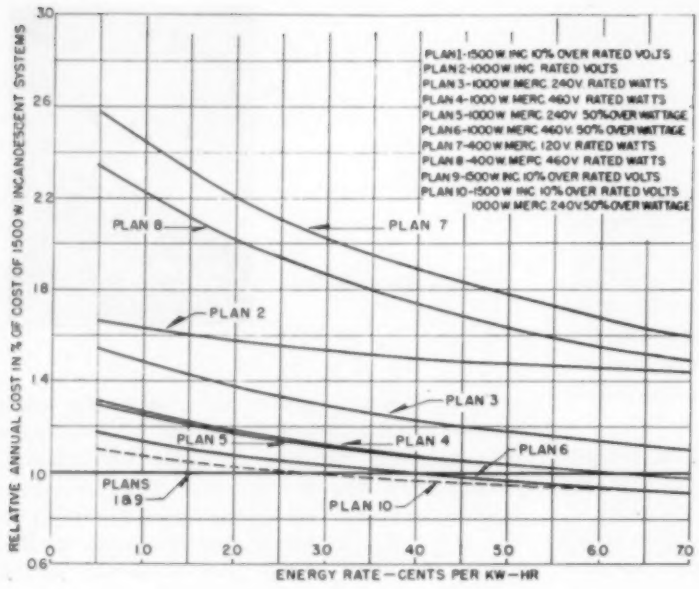

PLAN 1-1500 W INC. 10% OVER RATED VOLTS
PLAN 2-1000 W INC. RATED VOLTS
PLAN 3-1000 W MERC. 240 V. RATED WATTS
PLAN 4-1000 W MERC. 460 V. RATED WATTS
PLAN 5-1000 W MERC. 240 V. 50% OVER WATTAGE
PLAN 6-1000 W MERC. 460 V. 50% OVER WATTAGE
PLAN 7-400 W MERC. 120 V. RATED WATTS
PLAN 8-400 W MERC. 460 V. RATED WATTS
PLAN 9-1500 W INC. 10% OVER RATED VOLTS
PLAN 10-1500 W INC. 10% OVER RATED VOLTS
1000 W MERC. 240 V. 50% OVER WATTAGE
PLAN 8
PLAN 7
PLAN 2
PLAN 3
PLAN 5
PLAN 4
PLAN 6
PLANS 1 & 9
PLAN 10
RELATIVE ANNUAL COST IN % OF COST OF 1500 W INCANDESCENT SYSTEMS
ENERGY RATE—CENTS PER KW-HR

Figure 3. Effect of energy rate on relative annual cost of equivalent mercury and incandescent floodlighting systems—300 burning hours per year.

in a vertical or near vertical position, considerable distortion of the beam shape occurs when the lamp is used in conjunction with a plain lens, making the use of this type of floodlight rather undesirable.

With the fluorescent mercury lamp, a maximum of only around 20,000 candlepower can be obtained with conventional floodlighting equipment restricting the use of this lamp primarily to general area lighting and applications where short beam throws are required.

Beam Efficiency — On the basis of lumens per watt, the mercury floodlight will average from 1½ to 2 times more efficient than a filament floodlight; the beam efficiencies range from 5 to 20 per cent lower than an equivalent filament unit.

Other characteristics of the mercury source, such

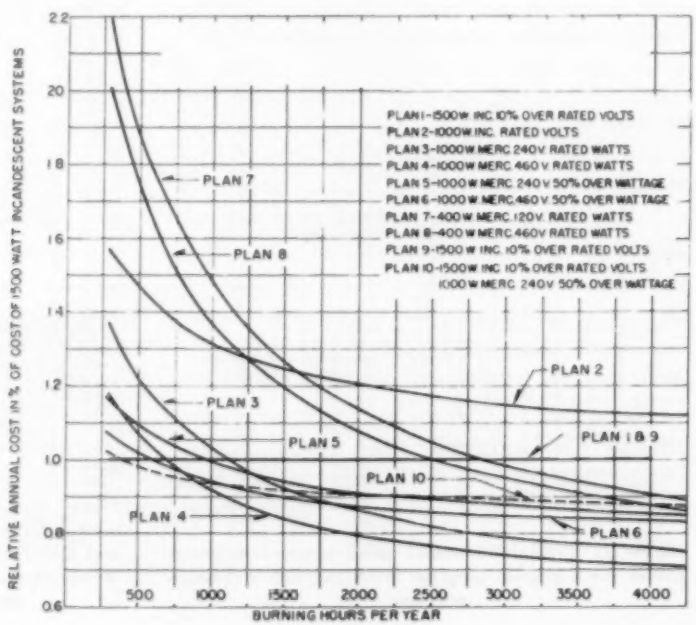

PLAN 1-1500 W INC. 10% OVER RATED VOLTS
PLAN 2-1000 W INC. RATED VOLTS
PLAN 3-1000 W MERC. 240 V. RATED WATTS
PLAN 4-1000 W MERC. 460 V. RATED WATTS
PLAN 5-1000 W MERC. 240 V. 50% OVER WATTAGE
PLAN 6-1000 W MERC. 460 V. 50% OVER WATTAGE
PLAN 7-400 W MERC. 120 V. RATED WATTS
PLAN 8-400 W MERC. 460 V. RATED WATTS
PLAN 9-1500 W INC. 10% OVER RATED VOLTS
PLAN 10-1500 W INC. 10% OVER RATED VOLTS
1000 W MERC. 240 V. 50% OVER WATTAGE
PLAN 7
PLAN 8
PLAN 2
PLAN 3
PLAN 5
PLAN 1 & 9
PLAN 10
PLAN 4
PLAN 6
RELATIVE ANNUAL COST IN % OF COST OF 1500 WATT INCANDESCENT SYSTEMS
BURNING HOURS PER YEAR

Figure 4. Effect of burning hours on relative annual cost of equivalent mercury and incandescent floodlighting systems—energy rate $0.02 per kilowatt-hour.

as stroboscopic effect, slow restarting after a power interruption, and color rendition should also be carefully considered before mercury lighting is recommended for any floodlighting application.

For an economic appraisal of mercury floodlighting, Fig. 3 illustrates the effect of the energy rate on the relative annual cost of various systems. The curves show that economically the 1000-watt mercury lamp compares very favorably to a 1000-watt filament system at rated volts while a rate of approximately 4 cents a kilowatt hour is required at 300 hours of operation a year before mercury floodlighting can economically compete with a 1500-watt filament system at 10 per cent over voltage.

Fig. 4 makes a similar comparison of the effect of burning hours on relative annual cost. With an energy rate of 2 cents per kilowatt hour, the 1000-watt mercury lamp requires approximately 1100 hours of operation a year and the 400-watt mercury lamp approximately 2800 hours a year to show an economic advantage over the filament systems.

Mercury floodlighting has been employed very successfully for many applications, but the study indicates that there is a definite need for more equipment designed especially to provide greater control and higher efficiencies with the mercury source before mercury can assume a prominent place in the floodlighting field. Until such equipment is available, the application of mercury floodlighting should be approached with a full understanding of its special characteristics and its limitations if a successful lighting job is to be achieved.

(Abstract of Conference Paper No. 20)

Lighting for Audio-Visual Teaching

Carl J. Allen

EDUCATION through the use of visual aids has increased greatly during the last few years. Since 1940, for example, the use of educational films in schools has increased over six times. Researches have shown that the rate of understanding and the degree of retention of material being taught are significantly improved by the proper use of films and slides. The term "proper use" implies proper integration with the educational program and proper presentation of the films or slides from a seeing environment standpoint. This paper deals with the seeing considerations involved.

With the many improvements which have been made in projectors, projector lamps, and projection screens, there has developed a generally held belief that it is no longer necessary to darken classrooms for projection. This can be true if a black and white line drawing slide is projected onto a directional type screen from a high-output projector and the viewer is standing beside the projector. However, if a projected photographic color slide or film is viewed from a position off of the screen axis, just a few footcandles of stray light from the windows will wash out the low contrast details in the slide.

The projectors in common use in schools are shown in Fig. 1. The opaque projector needs the most room darkening as its efficiency in producing screen brightness is only about $^1/_{10}$ lumen per projector-lamp watt; the 16 mm. projectors are about three times as efficient with efficiencies around $\frac{1}{3}$ lumen per watt Some of the 2 x 2-inch and $3\frac{1}{4}$ x 4-inch projectors have efficiencies up to 2 lumens per watt.

While 1000-watt projector lamps have generally been the largest used in 16 mm. and 2 x 2-inch projectors, new developments in $3\frac{1}{4}$ x 4-inch projectors are utilizing 3000- and 4000-watt lamps with screen lumens of 4000 and 6000 respectively. Typi-

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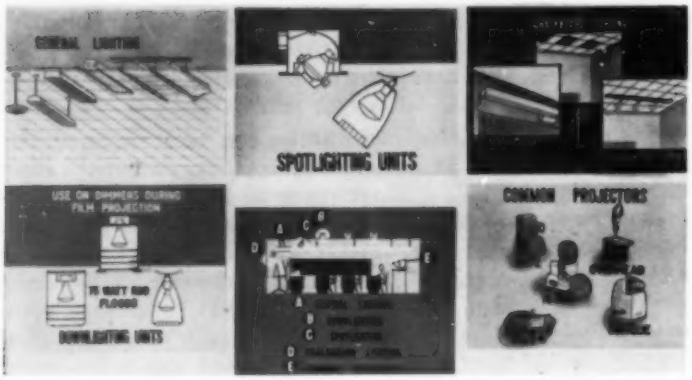

Figure 1. Examples of the various types of lighting which help make visual teaching more effective.

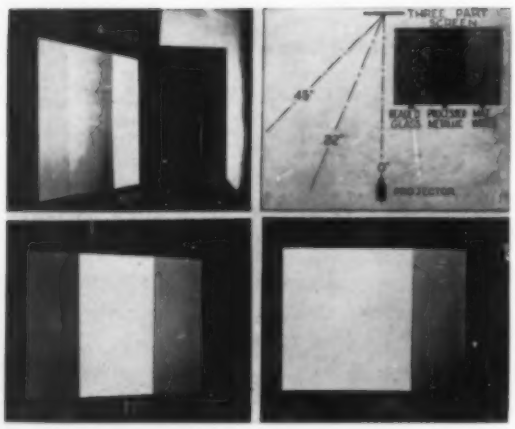

Figure 2. Three views of a demonstration screen which show the relative brightnesses of a glass-beaded screen, a processed metallic screen and a mat white screen at 0-, 22- and 45-degree viewing angles.

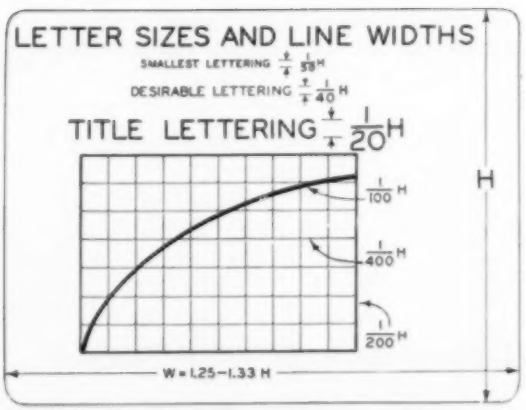

Figure 3. A guide for determining letter sizes and line widths for graphs which will assure good visibility under typical projection conditions.

cal 3¼ x 4-inch arc projectors produce about 7500 screen lumens.

The three basic types screens in use are the beaded-glass, the processed silver or finely ribbed aluminum, and the white mat screen. Each has its own reflecting characteristics. The processed silver or ribbed aluminum screen maintains the highest brightness in the usual seating zone as shown in Fig. 2. However, they are available only in flat panels and cannot be rolled up for portability like the beaded glass or white mat screens.

In addition to slides and films, the chalkboard, the tackboard, the maps, and charts used in school are also visual aids. Special lighting should be provided for these if the appeal to the visual sense is to be strong and effective. The spotlight and chalkboard lighting equipment shown in Fig. 1 is designed to serve this purpose.

As a guide to those preparing charts or slides, the letter sizes and line widths recommendations given in Fig. 3 are offered to assure good visibility. The assumption is made that the farthest viewer is seated a distance from the screen not more than six times the screen width.

With the trend toward greater use of visual aids, careful planning in the design of the visual environment features of the instructional areas is necessary in order to assure that the use of visual aids will be as effective as possible.

(Abstract of Conference Paper No. 7)

Abstracts of
I.E.S. Conference Papers on

Daylighting

Left to right:
J. W. Griffith
W. J. Arner
E. W. Conover

Daylighting Design with Adjustable Horizontal Louvers

THE PURPOSE of this research was to determine the quantity and distribution of the daylight illumination on the work plane of rooms employing adjustable horizontal louvers as a sun control and to develop a method of predicting the results. This paper reports on the findings of the study as carried on by the Daylight Study Project at Southern Methodist University under the sponsorship of Fenestra, Incorporated and Libbey-Owens-Ford Glass Company.

Since "Daylighting Design With Adjustable Horizontal Louvers" has an infinite number of possibilities, this research project was limited to louvers adjusted at 30°, 45°, and 60° from the horizontal with the inner edge of the louver tilted up. A louver geometry and reflectance of a typical venetian blind was used. Sun altitudes of 30°, 45°, and 60° were studied.

Tests were taken using $^1/_{12}$th scale models under both natural and artificial conditions. Over 600 interior tests were taken under artificial sky, ground, and sun conditions on models simulating lengths and widths of 20, 30, and 40 feet with ceiling heights of 8, 10, 12, and 14 feet. Since horizontal louvers are generally used with clear glass, all tests were taken on clear glass fenestration with louvers covering the entire fenestration area.

The prediction technique developed in this paper employs the use of tables of coefficients of utilization based on incident illumination rather than prediction curves used in previous papers.[1,2] The use of tables of coefficients of utilization greatly simplifies the prediction technique and presents a practical method for predicting the work plane distribution of daylight through clear glass fenestra-

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tion using adjustable horizontal louvers as a sun control.

The result of this study re-emphasizes the necessity for proper consideration of the light reflected from the ground in daylighting design. It also demonstrates that sunlight through clear glass fenestration and controlled by adjustable horizontal louvers provides both high quality and quantity of illumination on the work plane.

1. Griffith, J. W., Arner, W. J., and Conover, E. W.: "A Modified Lumen Method of Daylighting Design," ILLUMINATING ENGINEERING, Vol. L, No. 3 (March 1955).
2. Griffith, J. W., Arner, W. J., and Conover, E. W.: "Daylighting Design With Overhangs," ILLUMINATING ENGINEERING, Vol. LI, No. 3 (March 1956).

(Abstract of Conference Paper No. 1)

Left to right:
H. F. Kingsbury
H. H. Anderson
V. U. Bizzaro

Availability of Daylight

As has been previously reported, a project was started in March 1953 at Port Allegany, Pa., to measure the amount of daylight available on vertical planes facing the four cardinal points and the horizontal.

It is quite obvious, in determining some practical application of the data, that any "average" illumination data, for any elevation or period, is of little value to those interested in determining daylighting requirements for buildings. On the other hand, the number of hours per day the exterior illumination on certain vertical planes can be expected to be above a given level for any month is of value in such design. The data obtained therefore were analyzed with this point in mind. Furthermore, since these data are only applicable to Port Allegany, a means of transferring this information to other parts of the country was sought.

The United States Weather Bureau has, for some years, been measuring solar radiation incident on a horizontal surface at approximately one hundred different stations. Because sunlight is a portion of the total solar radiation, it was felt that such horizontal radiation data might be converted to illumination data on vertical planes, providing some means could be determined to correlate such conversions. Fortunately, simultaneous records of illumination and radiation incident on a horizontal surface were obtained at Washington, D. C. during 1954. These data show that on a monthly average one cal/cm^2 of radiant energy (Langley) is equivalent to 110 ft-c-hrs of illumination to within 10 per cent for any season of the year.

The conversion of such total illumination data to useful information on hours above a certain illumination level is dependent, at least at this time, on the development of an empirical relationship, so that this conversion can be accomplished with a minimum of expected error.

Using this relationship, it can be shown that one hour above 2600 ft-c is comparable to 6570 ft-c-hrs, with a maximum deviation of 9.4 per cent. Comparisons at lighting levels above or below 2600 ft-c give larger deviations.

Maps of the United States showing lines of constant solar radiation falling on a south vertical face

AUTHORS: Director, Daylighting Research Center, Research Engineer, and Laboratory Assistant, respectively, Pittsburgh Corning Corp., Port Allegany, Pa.

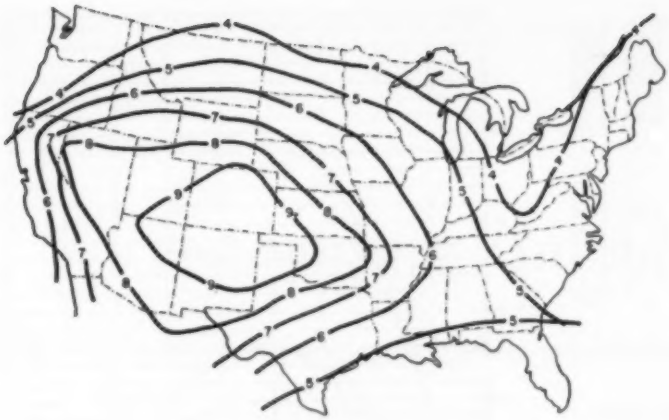


Figure 1. Average number of hours per day during January when the illumination level on a south vertical face is above 2000 footcandles.

during given months have been developed. It is possible to convert these maps to ones showing the number of hours a south face is above 2600 ft-c. The number of hours above 2600 ft-c is not, however, particularly advantageous to illuminating engineers. Exterior illumination levels of 1000 ft-c and 2000 ft-c are of more value. Fig. 1 shows a map for the month of January indicating the average number of hours a south vertical face is above 2000 ft-c.

The maximum error in converting radiation data to hours above 2000 ft-c by the method shown would be 26 per cent, with a possible maximum error in the neighborhood of 30 per cent for other localities.

Additional recordings of exterior vertical plane illumination, either in conjunction with radiation data or coordinated with near-by Weather Bureau data are required to further substantiate this present effort. For maximum difference in weather conditions, and testing of the methods contained in this paper, it would be desirable to take such data in a place or places remote from Port Allegany, say west of the Mississippi.

(Abstract of Conference Paper No. 2)

Measurements in Daylighted Classrooms in Arizona

J. R. Williams

ARIZONA, like the rest of the United States, has had tremendous increase in school construction since World War II. And like the rest of the country, these schools in Arizona have employed radical new designs, as compared to the pre-World War II school, to give maximum utilization of space and equipment. In the past few years many have studied and reported on different phases of these modern schools with special emphasis on heating, air-conditioning, classroom equipment, and lighting, both artificial and natural. Since a great effort has been made to design fenestration so as to take advantage of natural light, numerous studies have been made in the field and with test models to see if the designer is accomplishing the desired results.

This author believes that information from the Southwest on the results of classroom daylighting is needed from actual working examples since this section of the country has an extremely high percentage of clear days throughout the year. Also, this high percentage of clear days has encouraged

AUTHOR: Arizona Public Service Co., Phoenix, Ariz.

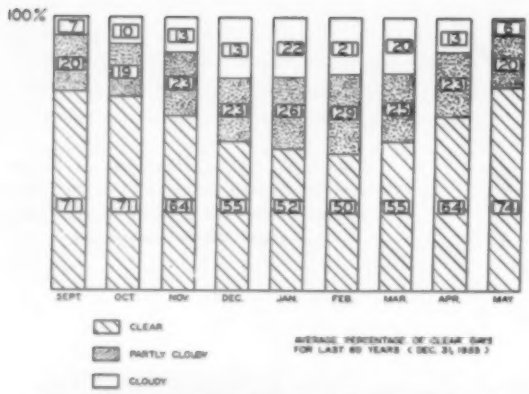


Figure 1. U. S. Department of Commerce, local climatological data, Phoenix, Arizona.

schoolroom designers in this area to try to take full advantage of this daylight in their fenestration design.

Sunshine in the Salt River Valley area of Arizona, as reported by the United States Department of Commerce's Weather Bureau, averages 85 per cent of the possible amount for the year—an unusually high normal, comparatively speaking. During the winter there are, on the average, only six or seven cloudy days per month, but the remainder of the time skies are sunny and daytime temperatures mild. In Spring, sunshine is at its best, shining between 80 or 90 per cent of the daylight hours during the three months of March, April and May.

In order to determine how much daylight illumination is provided with the fenestration in this sunny area, four post-World War II classrooms in different schools in separated localities in the Salt River Valley area of Arizona were selected for survey. In each test room, teachers were furnished with a light meter and classmates formed teams to measure the footcandle levels in nine locations in that room every hour that classes were in session. This survey was carried on for 45 school days in the months of January, February and March, 1956. Of the 15,000 readings that were taken, a very small fraction of one per cent of the total were discarded because of obvious inaccuracies.

An average was calculated for the footcandle readings in respect to identical hours and room positions for each day of the test period. With this information, curves for each position could be drawn with footcandles as ordinates and time (hours) as abscissas.

The accumulation of these data is for the purpose of adding a small bit of knowledge to the general art and science of schoolroom illumination. If there is any conclusion to be drawn, it would be

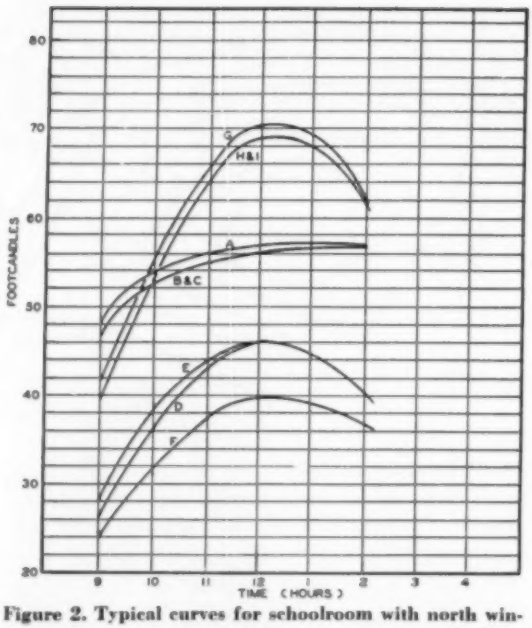


Figure 2. Typical curves for schoolroom with north window wall and monitor window in opposite wall from window wall. Richard C. Simis Elementary School.

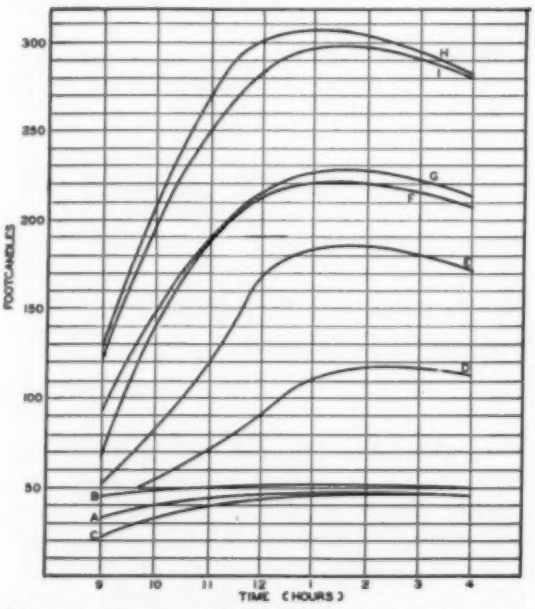


Figure 3. Classroom using sky domes instead of monitor window. Alphabetical letters refer to test positions in room. Window wall (A, B, C); center of room (D, E, F) inside wall (G, H, I). Washington High School.

that, as yet, the use of natural daylight for illumination purposes in classrooms has not been subjected to the precise control that is typical of artificial illumination.

(Abstract of Conference Paper No. 3)

Abstracts of
I.E.S. Conference Papers on

Lighting Calculations

Robert Swern Wiseman

Analysis of Experimental Data For Interflectance Theory

During the past decade investigators have reported data which show how the illumination and brightness measured in model or experimental rooms differ from the theoretical values calculated by the Interflectance Method. Primarily, these researches have utilized luminous surfaces as the sources since this method enables one to check the component factors separately. This paper summarizes these past investigations and shows the results obtained when two or more components are combined as in the case where luminaires inside the room cause the initial brightness of the surfaces.

"Correction factors," Table I, were determined from the data reported by Bull and by the author. These "correction factors" are values which, when used as multipliers, modify the theoretical values so they correspond more closely with the experimental values.

Author: Chief, Research and Photometric Section, Night Vision Equipment Branch, Electrical Engineering Dept., Engineer Research and Development Laboratories, Fort Belvoir, Va.

Three room shapes were selected to provide a wide range of room indices and calculations were made for lighting installations of three widely different types of luminaires. Room shapes and luminaire distributions are shown in the first part of Table II. k_r is calculated from the equation: (width plus length) (room height)/2 (width)

TABLE I — Component Correction Factors.

	Via Walls	Via Ceiling	Via Floor
Interflectance Factor	0.82	0.97	0.77*
B_{1m}/E	1.16	0.79	1.06
B_2/E	0.98	0.97	1.31
B_3/E	1.02	1.05	1.23
B_{1m}/B_0	0.95	0.77	0.82
B_2/B_0	0.81	0.94	1.02
B_3/B_0	0.86	1.02	0.95

*Direct flux to work surface is considered as a separate quantity.

TABLE II—Summary of Per Cent Variations Calculated for Studying the Effects of "Component Correction Factors" for the Interflectance Method. Reflectances: Wall 0.50, Ceiling 0.80, and Floor 0.30

	Cosine Direct		Uniform		Cosine Indirect	
R. I.	H(1.0)	C(3.0)	H(1.0)	C(3.0)	H(1.0)	B(4.0)
k_r	1.0	0.2	1.0	0.2	1.0	0.2
F_1	67%	26%	58%	28%	12%	3%
F_2	0	0	33%	44%	88%	97%
F_3	33%	74%	9%	28%	0	0
F_{WS-D}	51%	81%	15%	32%	0	0
	INTERFLECTANCE METHOD UNCORRECTED COMPARED TO CORRECTED*					
E	4%	5%	7%	6%	4%	3%
B_{1M}	7	10	11	13	24	28
B_2	19	5	10	8	7	6
B_3	9	7	9	5	0	−1
	INTERFLECTANCE METHOD UNCORRECTED COMPARED TO LUMEN METHOD					
E	−25	15	−15	32	1	39
	INTERFLECTANCE METHOD CORRECTED* COMPARED TO LUMEN METHOD					
E	−2	16	−5	30	−4	35

*Theoretical values modified by component "correction factors" and by using the true initial value of F_{WS-D} (lumens direct from luminaires to work surface) instead of using F_{WS-D} equal to the initial flux to the floor, F_3.

(length). F_1, F_2, and F_3 are the initial lumens from the luminaires to the walls, ceiling, and floor and F_{ws-d} is the number of lumens from the luminaires which are initially incident directly on the work surface.

The illumination values are least affected by the "corrections" and are most accurate when the ceiling lighting component predominates. There are wide variations between the values of illumination calculated by the Lumen Method and by the Interflectance Method.

Most of the theoretical brightness calculations predict values which are too high. Table II indicates the range of variations that might be expected.

(Abstract of Conference Paper No. 10)

J. R. Jones

John J. Neidhart

Algebraic Interflectance Computations

SINCE almost ninety per cent of our impressions come through our eyes, an efficient visual mechanism has great dollar value. This value is accentuated by the rising cost of labor. Thus, to improve worker productivity high illumination levels are justified. The tools available for selling high illumination levels plot productivity, visual acuity, etc. against background brightness which is proportional to illumination. So the customer gets interested in the illumination and he has a right to know what level to expect. Thus, illumination measurements are made. If computed predictions do not agree with measurements the lighting designer is embarrassed and the customer may be unhappy because he was sold the computed level. Thus, calculation accuracy is important.

Our accuracy has been improved tremendously in the past few years. But even the currently preferred method of computing coefficients of utilization still leaves much to be desired for certain luminaire distributions. Our accuracy is worst for indirect luminaires in high narrow rooms. For example, Potter and Russell found errors as high as 16.3 per cent for these conditions. Russell and Churchill found errors for these conditions as high as 18 per cent. The authors found similar results. All tests were made using computational factors that comprehended exact room conditions, and the finest instruments available were used for the measurements.

In an actual job in the field where errors would be caused by discrepancies between actual and assumed values such as output of the lamps, reflector efficiencies, room surface reflectances, etc., such accuracy is acceptable; but under laboratory conditions our accuracy must be improved if our field results are to be satisfactory.

The most accurate method yet devised for computing interior illumination utilizes the concepts of zonal multipliers and interflectance values. The zonal multipliers enable us to determine quite accurately the number of luminaire lumens directed by a lighting system to the walls, ceiling and floor (and work plane), and the interflectance values give us the per cent of these lumens that are reflected to the work plane. Any improvement in the accuracy of our system for computing illumination must be based on an improvement in the accuracy of either the zonal multipliers or the interflectance values. It is the purpose of this paper to present a new method for computing the interflectance values. Most of the values computed by this method are very close to those now in use. Some are identical. But others are considerably different. The ones that differ most are those that will improve the accuracy of our calculations for indirect luminaires in high narrow rooms.

(Abstract of Conference Paper No. 11)

AUTHORS: Westinghouse Electric Corp., Los Angeles, Calif., and The Miller Co., Meriden, Conn., respectively.

Interflections in a Room With Luminous Walls

Hempstead S. Bull

In order to obtain experimental verification of the well-known Moon-Spencer interflection equations for interiors lighted by luminous walls a small model room was constructed, having four luminous walls and painted masonite ceiling and floor panels. Provision was made to change the ceiling height at will, so as to obtain a wide range of room coefficients. After having determined the reflectances of the walls, ceiling and floor, numerous surface brightness readings were taken within the enclosure, together with footcandle readings of the illumination on a work plane parallel to the floor and separated from it by one-quarter the ceiling height. These data were obtained for each of five room coefficients, ranging from 1.0 (a cubical room) to 0.2.

Author: University of Michigan, Ann Arbor, Mich.

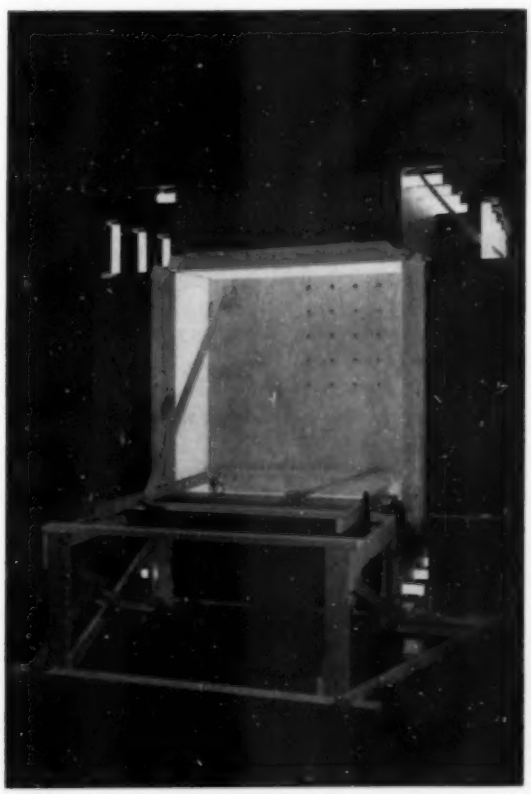


Figure 1. View of model room structure.

From all of these readings average values of four significant quantities were determined: (a) ceiling brightness, (b) floor brightness, (c) mid-wall brightness, (d) work plane illumination. In addition, the average wall brightness without interflection contributions was determined by removing one of the luminous walls and measuring its surface brightness while isolated from all other luminous surfaces. From these data the ratios of the four significant quantities listed above to wall brightness without interflections were computed and plotted as functions of room coefficients. These plotted ratios were then compared with similar ratios determined by use of the Moon-Spencer equations.

A Luckiesh-Taylor brightness meter was used for all observations and special holders were designed to support a 45-degree mirror and a magnesium oxide testplate, the latter being used in determining the work plane illumination.

Special care was taken in the construction of the luminous walls to attain uniformity of brightness and close approximation to the cosine law of emission. Each wall was a sheet of tracing vellum which formed one side of a plenum chamber containing four fluorescent tubes.

In general the significant brightness ratios obtained from experimental data were smaller than those computed from the Moon-Spencer equations by amounts that were considerably greater than could be attributed to observational and instrumental errors. It is concluded that the Moon-Spencer equations for interiors lighted by luminous walls need to be modified slightly to give results that will be more in line with what can be expected in conventional full-scale interiors where the reflectances of all painted surfaces will doubtless depart considerably from the cosine law.

(Abstract of Conference Paper No. 9)

Domina Eberle Spencer

The Effect of Furniture On the Coefficient of Utilization

THE LUMEN METHOD of lighting design is widely employed in practice. Neither in its original empirical form, nor when based on the theoretical foundation supplied by the interflection method is any consideration ordinarily given to the effect of furniture and other obstructions. Calculations based on the assumption of empty rooms are generally considered satisfactory. However, there are occasional cases in which irregularities in room contours cannot be ignored.

This paper makes a first step toward the development of more accurate procedures for calculating the coefficient of utilization in such cases. Irregularities in room contours are taken into account by: (a) Replacing the actual room (which contains obstructions such as furniture, recesses and beams) with a fictitious empty room, (b) Employing suitable average reflectances of walls, ceiling and floor of the fictitious room.

The key to the method is the development of a formula for the equivalent reflectance of a recess. The fraction of the light reflected back into the room from a recess of domance k_r with reflectance ρ_1 on the sides and ρ_2 on the top is called the *equivalent reflectance* ρ_{eq} of the recess. Values calculated from this equation are shown in the accompanying figure.

AUTHOR: Associate Professor, University of Connecticut, Storrs, Conn., and Consultant, Marlux Corp., Somerville, Mass.

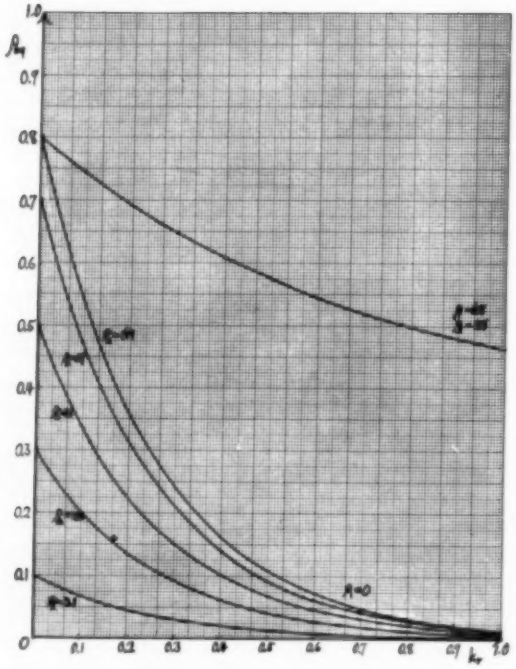


Figure 1. Equivalent reflectance ρ_{eq} of recess as a function of the k_r of the recess for various reflectances.

Two applications of the method are made. The effect of long rows of desks is analyzed. In the examples given in the paper, the error introduced by the presence of the furniture is between 2 per cent and 19 per cent. Largest errors occur when light furniture is used in large rooms and when the spacing between desks is slightly greater than their height.

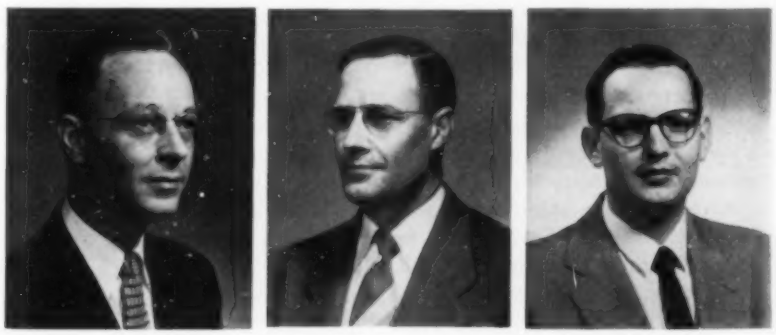
A second application is to determine the effect of structural beams on luminous ceilings. Even though such obstructions are painted white, interflections among the obstructions will lower the output of the luminous ceiling. In the examples worked out, with various beam depths and spacings, the error never exceeds 24 per cent but is frequently as high as 10 per cent.

(Abstract of Conference Paper No. 12)

Abstracts of
I.E.S. Conference Papers on

Lighting Research

Left to right:
Sylvester K. Guth
A. A. Eastman
J. F. McNelis



Lighting Requirements for Older Workers

MANY INVESTIGATORS have studied the effects of age upon visual and other functions of the human organism. Although most of the results have shown a decline in numerous biological functions with increasing age, only few criteria have been found suitable in visual tests for obtaining useful information applicable to lighting practice.

In order to provide additional knowledge, visibility measurements were made with the Luckiesh-Moss Visibility Meter by 100 typical office and laboratory workers whose ages ranged from 17 to 65 years. No selection of observers was made except to exclude those who had pathological or uncorrectable optical eye defects. The visual status of each observer was determined and, if necessary, lenses were provided to correct refractive errors for the experimental viewing distance of 16 inches. This was particularly important for presbyopic ob-

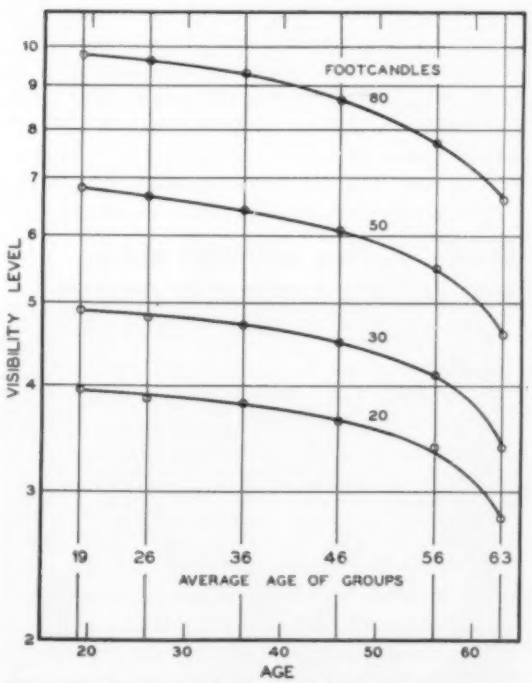


Figure 1. Illustrating how visibility level decreases with age. The data have been plotted in terms of the average age of each group.

AUTHORS: Lamp Division, General Electric Co., Nela Park, Cleveland, Ohio.

servers. Thus, insofar as was possible, all observers were placed on an equal optical basis. The visual task consisted of well printed 6-point type on white paper, illuminated by 10 to 100 footcandles.

The relationships shown in Fig. 1 illustrate how visibility decreases with age. The decrease is gradual up to the age of about 45 or 50, after which the change becomes more pronounced. The curves show that the visibility level achieved by the oldest group is about two-thirds of that obtained by the youngest group. All age groups receive approximately the same relative benefit—*i.e.*, percentage improvement in visibility—as the illumination is increased. When the illumination is raised progressively from 20 to 30, 50, and 80 footcandles, the improvement in visibility levels is 23, 68 and 142 per cent respectively.

A practical conclusion can be drawn from the data in Table I which represent the average footcandles required by the various age groups to obtain specific visibility levels. In order to achieve a visibility of 3, the oldest group needs about twice the illumination of that required by the youngest group. On the other hand, for a visibility level of 10, the former requires only 50 per cent more illumination than the latter. This would indicate, for older workers, an increasing effectiveness of percentage increases in footcandles. The difference

TABLE I — Average Footcandles Required by Observers in Various Age Groups to Obtain Specific Visibility Levels When Viewing 6-point Type at a Distance of 16 Inches.

Age Group	17-20	21-30	31-40	41-50	51-60	61-65	
Average Age	19	26	36	46	56	63	
No. of Observers	12	17	22	21	21	7	
Visibility Level	Footcandles						Average All Groups
3	11	12	12	13	16	23	14
4	20	21	22	24	28	40	25
5	31	33	33	36	43	56	37
7	52	53	56	61	71	85	61
10	82	83	87	94	105	117	93

required by the oldest observers (94 per cent) for visibility levels of 3 and 10 is greater than the difference needed by the youngest group (71 per cent). This would mean that the older observers require a greater increase in *brightness difference* than younger observers for the same improvement in visibility.

The data obtained in this investigation emphasize that the differences among individual observers and various age groups are important factors which should be taken into consideration when developing recommended levels of illumination.

(Abstract of Conference Paper No. 22)

EFAS—A New and Vital Aid to Low Visibility Landings by Aircraft

Donald I. Coggins

THIS PAPER describes the operation and function of the Electronic Flash Approach System (EFAS) as a key component of the integrated Aircraft Visual Landing System evolved by the C.A.A., ATA, ALPA, and participating lighting manufacturers. The success of low visibility landings may be related directly to the timeliness and spontaneity of the transition from Instrument to Visual flight during approach and the degree to which the necessary aids provide the required information and guidance without loss of eye sensitivity. EFAS contributes the essential ingredients to accomplish these objectives and in combination with other more conventional light sources arranged in a unique configuration and radio approach aids provides a complete solution to landing of aircraft under low visibility conditions.

AUTHOR: Sylvania Electric Products Inc., Lighting Division, Salem, Mass.

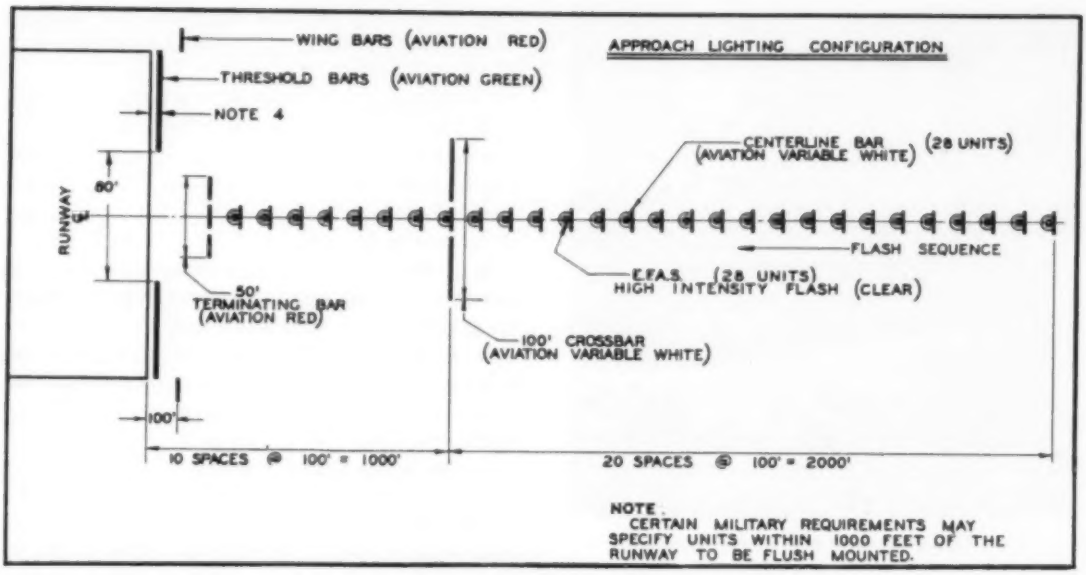

APPROACH LIGHTING CONFIGURATION
WING BARS (AVIATION RED)
THRESHOLD BARS (AVIATION GREEN)
NOTE 4
CENTERLINE BAR (AVIATION VARIABLE WHITE) (28 UNITS)
RUNWAY
60'
FLASH SEQUENCE
E.F.A.S. (28 UNITS) HIGH INTENSITY FLASH (CLEAR)
50' TERMINATING BAR (AVIATION RED)
100' CROSSBAR (AVIATION VARIABLE WHITE)
100'
10 SPACES @ 100' = 1000'
20 SPACES @ 100' = 2000'
NOTE
CERTAIN MILITARY REQUIREMENTS MAY SPECIFY UNITS WITHIN 1000 FEET OF THE RUNWAY TO BE FLUSH MOUNTED.

Figure 1. Typical installation, airport approach lighting.

The Urgency for Improved Air Traffic Control. During the past ten years plane hours in the United States have doubled and passenger miles have more than tripled. Last year Chicago's Midway Airport alone handled, on the average, more than 1,000 planes and close to 25,000 passengers a day.

Unfortunately facilities for the control of this sort of traffic growth have not kept pace despite all efforts of the Civil Aeronautics Administration with available funds. Bad weather still plagues air travel frequently causing delays and diversions to other airports less affected.

Such conditions cause serious inconvenience to passengers and financial loss to both airports and air carriers. In addition, the maintenance of high standards of safety require immediate implementation of present facilities particularly with anticipation of further growth and the coming of jet planes.

New Visual Landing Aids

Fortunately there exist today proven facilities for almost completely licking the problem of low visibility landings. Through the combined efforts of C.A.A., the Air Transport Association of America, the Air Line Pilot's Association and the lighting industry, an Electronic Flash Centerline Approach Lighting System has been evolved. It has already proven through installation at both Idlewild and Newark Airports, its ability to essentially solve this phase of air traffic control.

The complete integrated system is shown in Fig. 1 and comprises a 3000-foot line of lights centrally placed in front of the runway. It combines all the ingredients necessary to guide a pilot visually from the normal termination of radio approach aids to the runway.

Electronic Flash (for fog penetration, identification and directional guidance). The heart of the system is the line of 28 condenser discharge units (See Fig. 2) which flash in rapid-fire sequence towards the runway in one-half second cycles. Since each distinctive blue-white flash lasts but a few hundred microseconds and attains a peak beam out-

Figure 2. Electronic flash unit.

Figure 3. Incandescent bar unit.

put of some 30 million candlepower, exceptional conspicuity results without the usual fog blinding and glare of high intensity steady burning lights. Despite the very short flash duration, total integrated light is in excess of 10,000 candles providing excellent fog penetration and powerful eye attraction. The resulting streaking ball of light gives strong directional guidance and positive identification permitting early transition from instrument to visual flight.

A recent article by Professor H. E. Edgerton[2] of M.I.T. and others provides excellent information on the efficiency of flash tubes of this type.

Bar Incandescent Lights (for roll guidance and height indication). Combined with the Electronic Flash System is an equal number of 14-foot, 5-lamp steady burning, adjustable intensity bar units (See Fig. 3). Such units are essential to an orderly transfer from full instrument to visual flight. An excellent study and exploration of similar units and configuration has been made by Mr. E. S. Calvert[1] of Great Britain.

Because of their physical size and placement these units provide the missing horizon in bad weather giving clear and continuous roll guidance. Familiarity with their size and spacing also serves to give height reference. In bad weather, the intensity of these steady burning lights must be substantially reduced to prevent fog glare and blinding which would destroy the dark adaptation of a pilot's eye at night.

Terminating Aids Prior to Touchdown (for distance and runway imminence information). Reference to Fig. 1 shows a 100-foot clear light crossbar located 1000 feet from the runway. This facility provides one positive and unmistakable indication of distance to the runway.

At a distance of 200 feet from the runway is located an 80-foot red bar of steady light pointing out the end of the approach lights.

At a distance of 100 feet of the runway are located two 14-foot red wing bars marking the lateral extremity of the approach and runway areas.

At the approximate beginning of the runway surface is placed a line of green threshold lights giving final touchdown clearance.

Runway Guidance. Current standards of runway edge lighting are inadequate for proper guidance once the plane touches the runway.

The cause of this inadequacy is primarily the angular limits of acuity of the eye to view these lights far to the side. An excellent description of this problem and its possible solution has been written by Mr. A. E. Jenks[3] of the C.A.A.

The Future

Today as never before is improved air traffic control necessary. C.A.A. and the airlines have been constantly aiming to improve this situation in order to keep pace with the rapid growth of the industry. The prompt implementation of current radio approach aids with available and proven visual aids as described above is already programmed by C.A.A. but drastically improved time schedules are needed for which much-sought-for funds must be made available.

Such a program with full standardization of facilities both here and in other countries will go far in establishing sound air traffic control in and about our airports.

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1. Calvert, E. S.: "Visual Aids for Low Visibility Conditions," *Journal of the Royal Aeronautical Society*, 1948, Vol. 52, pp.. 439-472.
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(Abstract of Conference Paper No. 24)

The Evaluation of Discomfort Glare

Glenn A. Fry

THERE are at present at least three numerical assessments that one can apply to a light source to express its capacity for producing discomfort: (1) the glare rating G, (2) the BCD index M and (3) the visual comfort index (VCI) which represents the percentage of a sample of normal observers for whom the light source is comfortable. A definite relationship exists between G and M so that one can be computed from the other and each can be related to the percentage of comfortable people, as shown in Figs. 1 and 2. An M value of 108 and a G value of 55.6 represent the levels on the two scales at which 50 per cent of the observers are comfortable.

On the surface it might appear that Luckiesh and Guth[1] and Harrison and Meaker[2,3] have used different methods for making an allowance for the displacement of a glare source from the line of sight in evaluating its capacity to produce discomfort; however, it is possible to derive the following equation which relates the position index P of Luckiesh and Guth to the location coefficient L of Harrison and Meaker:

$$P^2 = \frac{220}{L\,(Y^2/H^2 + W^2/H^2 + 1)}$$

where

H = the height of the glare source above eye level,

Y = the lateral displacement from the median plane in feet, and

W = the distance from the eye to the frontal plane through the glare source in feet. By means of this equation values of L can be computed from values of P.

There is no fundamental difference in the basic principles involved in evaluating the capacity of a glare source for producing discomfort represented in the methods of Harrison and Meaker,[2,3] Luckiesh and Guth[1] and Logan and Lange.[4] The methods differ only in the use of different coefficients and exponents and different sets of values for the position index P. The procedures also differ in evaluating the brightness of the surround and the method of Harrison and Meaker attempts to make some allowance for the immediate brightness of the background.

The Logan-Lange method of evaluating a multiple number of glare sources if modified to make it self-consistent, becomes identical with the Harrison-Meaker method. Although the principle of additivity of Harrison and Meaker does not encompass all of the experimental facts and also has certain theoretical limitations, it may still be regarded as a usable approximation.

Guth[5] has recommended a different method of evaluating the combined effect of a number of glare sources.

There are too many unknowns to construct a

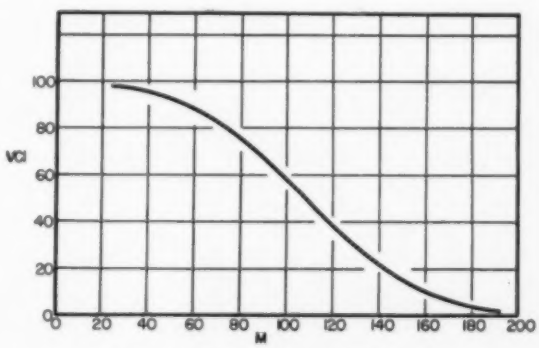

Figure 1. The relation of VCI to M.

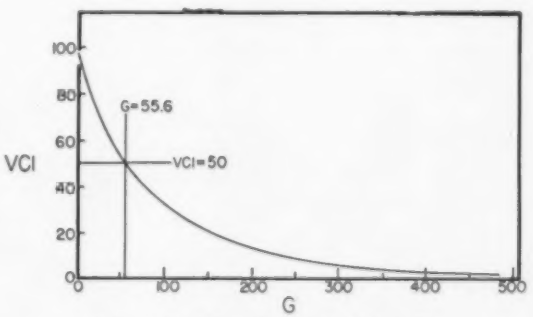

Figure 2. The relation of VCI to G.

AUTHOR: School of Optometry, Ohio State University, Columbus, Ohio.

perfect system for evaluating glare in a luminous environment, but the illuminating engineering profession should be able to formulate and adopt a tentative standard system for performing this operation.

1. Luckiesh, Matthew, and Guth, S. K.: "Brightness in the Visual Field at Borderline between Comfort and Discomfort (BCD)," ILLUMINATING ENGINEERING, Vol. XLIV, p. 650 (1949).

2. Harrison, Ward, and Meaker, Phelps: "Further Data on Glare Ratings," ILLUMINATING ENGINEERING, Vol. XLII, p. 253 (1947).
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4. Logan, H. L., and Lange, A. W.: "The Evaluation of Visual Comfort Data," ILLUMINATING ENGINEERING, Vol. XLVII, p. 195 (1952).
5. Guth, S. K.: "Subjective Additivity of Areas of Brightness," Presented at the International Commission of Illumination, Zurich (June 1955).

(Abstract of Conference Paper No. 23)

Discussion of Conference Papers

Written discussion on any of the technical papers presented at the National Technical Conference should be submitted immediately for publication with the paper in ILLUMINATING ENGINEERING.

Send: One copy (original) to Miss Ruby Redford, Editor, ILLUMINATING ENGINEERING, 1860 Broadway, New York 23, N. Y.

One copy to author of the paper.

One copy to Discussion Organizer of the session (listed below).

One copy to H. F. Davidson, Chairman, I.E.S. Papers Committee, Hydro-Electric Power Commission of Ontario, 620 University Ave., Toronto, Ont.

Discussion Organizers

Daylighting — Monday afternoon, September 17, Papers Nos. 1, 2 and 3 — E. M. Linforth, Rohm Rohm & Haas, Bristol, Pa.

Applications I — Monday afternoon, September 17, Papers Nos. 5, 6, 7 and 8 — Norman T. Kridel, Rochester Gas and Electric Corp., 89 East Ave., Rochester 4, N. Y.

Calculations — Tuesday morning, September 18, Papers Nos. 9, 10, 11 and 12 — W. V. C. Foulks, Curtis Lighting Inc., 6135 65th St., Chicago 38, Ill.

Light Sources I — Tuesday morning, September 18, Papers Nos. 16, 29, 31 and 32 — J. Roland Morin, Sylvania Electric Products Inc., 75 Sylvan, Danvers, Mass.

Applications II — Thursday morning, September 20, Papers Nos. 20, 21A and 21B — E. H. Raddin, Champion Lamp Works, Lynn, Mass.

Research — Thursday morning, September 20, Papers Nos. 22, 23 and 24 — Commander Dean Farnsworth, U. S. Naval Submarine Base, Medical Research Laboratory, Box 45, New London, Conn.

Street Lighting — Thursday afternoon, September 20, Papers Nos. 25, 26, 27 and 28 — Dana Rowten, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland 1, Ohio.

Light Sources II — Thursday afternoon, September 20, Papers Nos. 13, 14, 15 and 30 — C. M. Holden, Champion Lamp Works, Lynn, Mass.

INSTALLATION AT ALDON RUG MILLS, LENNI, PA.

Lighting for Machine Sewing

LIGHTING OBJECTIVE: To provide high level illumination at the needles on the sewing machines without objectionable shadows and without the usual limitations of machine attached localized lighting.

GENERAL INFORMATION: Sewing machines for producing small rugs are located in the room shown above. The room dimensions are approximately 40 feet 6 inches by 72 feet 6 inches with a ceiling height of 9 feet 4 inches. Colors and reflectances are as follows:

	Color	Reflectance
Ceiling	White	78%
Walls	Light Green	55%
Floor	Maple	18%
Sewing Machine table tops	Maple	24%
Racks	Grey	46%
Sewing Machine head	Black	5%

(over)

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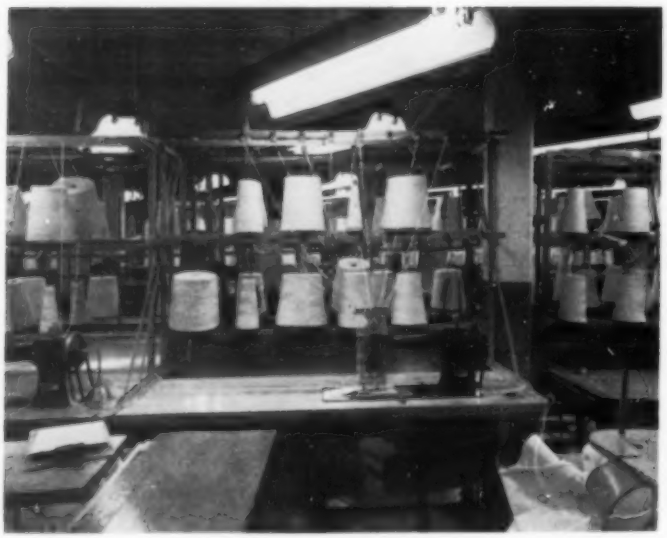

Figure 2. Close-up of machine table.

INSTALLATION: General illumination is provided by 68 industrial fluorescent luminaires (Sylvania Electric Products, Inc. catalog No. HF-100) individually mounted 7 feet above the floor and oriented 45 degrees with respect to the machine table as shown in Fig. 2. Each luminaire is 4 feet long and equipped with two 40-watt T-12 standard cool white preheat starter type lamps.

The average level of illumination is 41 footcandles. The illumination within a 9-inch radius of the machine needles is 91 footcandles. There are no objectionable shadows. Brightnesses are as follows:

Ceiling	12 ft-L
Walls	10 ft-L
Floor	9 ft-L
Sewing Machine table tops	22 ft-L
Racks	9 ft-L
Sewing Machine head	4 ft-L

Lighting designed by William N. Harrison, Lighting Engineer, Philadelphia Electric Co., Philadelphia, Pa.; Electrical Contractor, Charles A. Holm, 727 16th Ave., Prospect Park, Pa.

Lighting data submitted by George T. Anderson, Jr., Philadelphia Electric Co., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Lighting and Airconditioning...

Part 1 — The Lighting System's Relation to the Cooling Load

Prepared by a Joint Committee on Lighting and Airconditioning of the Illuminating Engineering Society and the American Society of Heating and Airconditioning Engineers

A joint committee was appointed "to study the relationships between lighting and the various factors that enter into air conditioning and report thereon." Representatives from the American Society of Heating and Air Conditioning Engineers submitted questions on lamps and lighting which the I.E.S. answered. Since most of those questions have appeared in ILLUMINATING ENGINEERING previously in the Light Sources Committee's Questions and Answers page and the others are based on lamp data in the *I.E.S. Lighting Handbook*, they will not be published again by the I.E.S.

The following questions on cooling systems were asked by I.E.S. members and answers obtained by the Joint Committee from air conditioning engineers.

JOINT COMMITTEE ON LIGHTING AND AIR CONDITIONING

AMERICAN SOCIETY OF HEATING AND AIR CONDITIONING ENGINEERS
John Everetts, Jr.
A. T. Jorn
J. N. Livermore

ILLUMINATING ENGINEERING SOCIETY
Walter Sturrock, *Chairman*
R. W. McKinley
E. H. Salter

QUESTION — For practical purposes, should the illuminating and air conditioning engineers assume that 100 per cent of the wattage consumed by luminaires be included in the design cooling load of an air conditioned building?

ANSWER — It is present practice to assume that the instantaneous load on an air cooling system due to lighting is equal to 100 per cent of the rate at which electrical energy is supplied to the lighting system. It is recognized, however, that a portion of the total energy output of a luminaire is in the form of radiant energy and that part of this energy is stored in the structure of a building by raising its temperature. Hence, the instantaneous cooling load may be less than the instantaneous power input to the lighting system. However, because of the lack of data on this heat storage effect, conservative design requires the practice of considering 100 per cent instantaneous conversion of lighting load to cooling load. Similarly, conservative design of heating systems usually ignores the heat supplied by the lighting system.

Because the energy input to a lighting system is not always constant during the day, and because it usually is zero during a part of a 24-hour period, it constitutes a periodically varying heat input to an air conditioned space. Under such condition, part of the radiant output of luminaires warms the structure at varying rates during the "on" periods, while the rest is convected from the room surface to the room air. It is this portion, plus the convected heat from the luminaire itself, that be-

Approved by the Council of the Illuminating Engineering Society, October 1955.

comes an instantaneous load on the air cooling system. During the "off" periods, heat stored in the structure returns to the space as convected heat.

In general, therefore, the instantaneous load is less than the instantaneous input during the "lights on" part of the cycle, but there will usually be a load on the cooling system during the "lights off" part of the 24-hour cycle. Whether or not the total amount of heat that must be removed by refrigeration during a 24-hour period equals the total electrical energy input to the system depends upon how much outside air can be used for cooling at certain periods of the day, and upon the amount of energy lost by transmission of high temperature radiant energy through glass areas or by conduction through the outer walls of the building.

In certain lighting arrangements, a portion of the system may be so located that some heat can be carried away by a separate ventilating system which uses outdoor air. In some cases, light troffers can be liquid cooled so that energy absorbed by or conducted into the troffer can be carried away by the coolant. Liquid-cooled ceiling panels perform in a similar way. Although these two methods reduce the load on the air cooling part of the system, they do not reduce the total load on the refrigeration system, if the coolant is cooled by mechanical refrigeration. Obviously, the component so removed will not at any time be stored in the structure. The luminous ceiling method of lighting in which the space is used as a plenum for conditioned air or a passageway for cool-air ducts, presents a still different problem for the air conditioning engineer.

Because the problems of accurately relating lighting load to cooling load are so varied, and because the energy from lighting systems constitutes in many cases a large part of the total cooling load, the entire problem is a part of the long-range research program of the ASHAE. Certain sections of the problem are being attacked in current research. Some insight into the problem and some useful data have been developed in past research by several individuals, whose findings appear in the technical literature. However, much more data are needed. A well-planned research program can bring results. Active participation of the IES in the ASHAE program is invited.

QUESTION — In considering the components of the total energy released by lighting units, reference is frequently made to "low-temperature" and "high-temperature" radiation. What is the difference between these two types of radiation?

ANSWER — In many problems faced by air conditioning engineers, especially in connection with lighting and solar radiation, radiant energy sources can be conveniently classed as producing high or low temperature radiation. The dividing line between these two radiations is the wavelength, between 4000 and 5000 millimicrons,[1] at which glass becomes completely opaque to radiation. Glass is completely opaque to all radiation of longer wavelengths. For radiation of wavelengths shorter than 4000 to 5000 millimicrons, glass is transparent to a degree depending upon its composition. Substantially all radiant energy from the sun either in the direct beam or in the scattered solar radiation, and all of the radiant energy from filament lamps which passes through the glass enclosure of the lamp, is of wavelength shorter than 4000 to 5000 millimicrons. Most of it is shorter than 3000 millimicrons. This radiant energy is termed high-temperature radiation because of the high temperature of the source. An exception to this high source temperature is the radiant energy from a fluorescent tube.[2] Here the source temperature is low, but the energy is short wave, most of it shorter than 1000 millimicrons.

By contrast the temperatures of most other sources in air conditioned spaces rarely exceed 500 F,[1] approximately the highest temperature reached by the bulb of a filament lamp. Glass is almost completely opaque to all radiation from sources of such a temperature or lower. Hence, such sources can be classed as low-temperature radiators.[1] It is noteworthy that most painted and non-metallic surfaces have low reflectances for low-temperature radiation, but their reflectances may be very high for high-temperature radiation. Computation work is often facilitated by this arbitrary classification of radiation energy components.

QUESTION — What do the ASHAE designers mean when they speak of "sensible heat" and "latent heat"?

ANSWER — Chapter I of the *ASHAE Guide* gives the following definitions:

SENSIBLE HEAT — "A term used in heating and cooling to indicate any portion of heat which

1. A blackbody heated anywhere up to 500 F radiates wavelengths predominately longer than 4000-5000 millimicrons. A blackbody heated much higher, to where light is given off, radiates wavelengths predominately shorter than 4000-5000 millimicrons.
2. A fluorescent tube does not act as a blackbody. The wavelengths of most of the radiant energy are dependent upon the phosphors used and not upon the source temperature.

changes only the temperature of the substance involved." In other words, it is the heating required to make air warmer or heat removed to make air cooler.

LATENT HEAT—"A term used to express the energy involved in a change of state." In other words, it is heat required to evaporate water for humidifying air in winter, or heat removed to condense vapor for dehumidifying air in summer.

QUESTION — The equipment for cooling systems is sometimes rated in horsepower, other times in tonnage. In the latter case, what basis should the electrical engineer use to size the motors and services?

ANSWER — Unfortunately, the use of both "tons" and "horsepower" in referring to the rating of air conditioning equipment has fallen into common usage. For air conditioning comfort cooling, the refrigeration machine will require approximately one horsepower for every ton of refrigeration developed. For small installations where self-contained units of five horsepower or less are used the total horsepower for the job will run approximately one horsepower per ton, *i.e.*, on a five horsepower unit the compressor motor will be five horsepower and the fan motor from one-third to one-half horsepower. As the size of the installation increases and systems other than the self-contained unitary type are used, the horsepower requirements of the refrigeration machine will vary with evaporator temperature and condensing temperature. The horsepower per ton of a refrigerating machine will increase with a drop in evaporator temperature and an increase in condensing temperature. The following table is an example of this variation.

TABLE I.

	Condenser	
	Air Cooled	Water Cooled
Evaporator Temperature	50 F	50 F
Air Temperature	70 F	——
Condenser Water Temperature	——	70 F
Horsepower per Ton	0.97	0.64
Raise air temperature to 100 F for the air cooled machine and the condenser water to 90 F for the water cooled machine.		
Evaporator Temperature	50 F	50 F
Horsepower per Ton	1.40	1.01
Drop the evaporator temperature to 30 F and use 100 F air and 90 F water.		
Evaporator Temperature	30 F	30 F
Horsepower per Ton	1.60	1.46

The electrical engineer should consult with the mechanical engineer before sizing motor starters, wiring and incoming services for air conditioning installation.

However, the auxiliaries, such as the fans, chilled water pumps, cooling tower pumps, cooling tower fans and miscellaneous motors, may range anywhere from .25 horsepower per ton to 1.0 horsepower per ton in addition to the refrigeration. This, of course, depends upon the type of system used, location of equipment, etc. Unfortunately, there is no general rule that can be established within reasonable limits to set up the total horsepower requirements for a given job until after the job has been fairly well designed. The popular concept of "one horsepower per ton" for air conditioning should be discouraged as it is completely false.

QUESTION — When the illuminating engineer specifies fenestration and luminaires for a room, does he influence to any extent the cost of installing and operating air conditioning for that room?

ANSWER — Room lighting, whether solar or from interior luminaires, is an important part of the air conditioning cooling load in many cases. This will, of course, be correspondingly reflected in the capacity, first cost and operating cost of the refrigeration equipment and the room cooling system.

The relative magnitude of the lighting load to other heat sources varies widely between buildings and between various parts of a given building. In this respect, it may be of interest to point out the more common heat load components and to cite a few actual cases showing their relative influence on the air conditioning design.

Usual sources of heat which must be removed from a comfort-cooled room are:

(1) Heat transmitted through window glass.

(2) Heat transmitted through other enclosing materials.

(3) Heat from electric lighting elements.

(4) Heat from occupants.

(5) Heat from outdoor air inflow due to exterior doors, etc.

All of the above are called "interior load" and affect the required capacity of the system used to cool the room, *i.e.*, ducts and fans or pipes and pumps.

In addition to these, a sixth important source of refrigeration load is the heat which must be removed from outdoor air before it is used for ventilation.

Following is an example of interior load distribution in a particular modern office building. In this instance the amount of exterior masonry is so small its heat gain is neglected. Provision was made for fluorescent lighting at 5 watts per square foot (approximately 75 to 85 footcandles). It was assumed that the occupants would follow their usual habit of lowering the venetian blinds on the sunny side of the building and turning on the lights.

TABLE II.

Heat Source	EXTERIOR OFFICES* North	East	South	West	INTERIOR OFFICES
Glass	27%	56%	51%	56%	—
Lights	61	37	41	36	84%
Occupants	12	7	8	8	16
	100%	100%	100%	100%	100%

*Per cent at time of maximum load in each office.

TABLE III.

	Office Building A	Loan Office B	Chain Store C	Clinic D
Glass	11.8%	27.0%*	5.7%	14.8%
Lights	42.3	12.9	23.3	16.9**
Roof and Walls	0.7	16.8	12.0	33.4
Occupants	15.4	12.2	33.4	15.5
Ventilation	26.6	31.1	21.4	19.4
System Power	3.2	——	4.2	——
	100.0%	100.0%	100.0%	100.0%
Glass + Lights	54.1%	39.9%	29.0%	31.7%

*Large expanse of window exposed west.
**Assumes 50% of lights in use.

For the building shown in Table II, the relative magnitude of all heat sources at the time of total building peak cooling load was found to be as shown in Column A of Table III. For the purpose of comparison, analyses of total cooling load for other recent installations are shown in Columns B, C and D. Heat from lighting in Columns B and C was calculated at 3 watts per square foot of floor (approximately 40 to 50 footcandles) and Column D at 2.5 watts per square foot (approximately 35 to 40 footcandles).

QUESTION — In what way may the location and design of the artificial lighting units affect the distribution of air?

ANSWER — The arrangement of lighting units which project below the ceiling can seriously disturb the flow of incoming air from diffusers. Where luminaires deflect this primary air stream, downdrafts usually result and are troublesome. Such situations can be avoided only by close cooperation between the architect and the lighting and air conditioning designers on the particular project.

QUESTION — In practice, should the illuminating and air conditioning engineer consider that both the total heat output of the luminaires and the total heat load of the fenestration be included in the design cooling load of an air conditioned building?

ANSWER — Though it is common engineering practice today to include both the *total* cooling load related to electric lighting and the *peak* cooling load related to the fenestration or daylighting system in the *design* cooling load for an air conditioned building, it is likely that only part of these loads is actually imposed on the cooling system simultaneously in common operating practice.

It is safe to assume that in spaces within 30 feet of an outside wall, a sizeable heat gain contributed by solar radiation through sidewall fenestration will be associated with sufficient daylight illumination that operation of the electric lighting system will not be necessary. Similarly, where an adequate electric lighting system is operated continuously, fenestration shading devices usually are adjusted for most effective reduction of solar heat gain and glare during periods of peak solar load (August 1, West elevation).

Zonal integration of air conditioning distribution and automatic photoelectric-cell control both of electric lighting and of fenestration shading warrant special study as it may contribute materially to the achievement of a satisfactory total environment at minimum initial and long term operating cost to the building owner.

QUESTION — What is meant by "instantaneous heat gain," "air cooling load," "design cooling load" and "equipment or refrigeration load"?

ANSWER — These terms are commonly used in the air conditioning profession and literature, but have not been standardized in their meaning by ASHAE definition. In general, the following are the accepted meanings:

INSTANTANEOUS HEAT GAIN — The rate at which heat enters or is created in the space at a specified critical time — usually the time of maximum heat gain as established by experience or calculation. The usual sources are people, equipment, luminaires, sunshine through

fenestration, conduction through all room surfaces, and infiltration of outdoor air around windows and doors.

AIR COOLING LOAD — The instantaneous rate at which heat is to be removed by passing cooled air through the space. This differs from the "Instantaneous Heat Gain" due to one or more of the following: (1) Acceptance of a small rise in temperature of the space air during the warmest part of the hottest days each season. (2) Storage of radiated heat in the building internal structure and furnishings each day with complete release before the next morning. (3) Removal of part of the heat by other means (such as local water cooled or air cooled "radiant" cooling panels or luminaires, or local water cooled air cooling coils).

DESIGN COOLING LOAD — The maximum rate at which the designer estimates heat will have to be removed from the space. In the past this has usually been the same as the "Instantaneous Heat Gain" since so little has been known about evaluating structural storage of heat and it has been the general practice to hold the space air temperature constant. It has also usually been the same as the "Air Cooling Load" since it has not been common practice to install localized equipment to accumulate heat in water for removal by that medium.

EQUIPMENT OR REFRIGERATION LOAD — The maximum rate at which heat is to be removed by the equipment. This differs from the "Design Cooling Load" in that it also includes the heat removed in cooling and dehumidifying the air taken in through the air conditioning equipment for building ventilation.

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Annual Meeting

In accordance with Article VIII Section 1 of the Constitution, the Annual Meeting of the Illuminating Engineering Society is scheduled to be held at Society Headquarters at 10:00 a.m., Thursday, October 11, 1956. The meeting will receive a report of the proceedings of the Society for the fiscal year 1955-1956.

George J. Taylor
General Secretary

A.I.A. File No. 31-f

INSTALLATION AT MASLAND DURALEATHER, AMBER AND WILLARD STS., PHILADELPHIA, PA.

Lighting for Inspecting Fabrics

LIGHTING OBJECTIVE: To provide general illumination for inspection to detect flaws in material and printed design of vinyl fabrics.

GENERAL INFORMATION: The area shown is 94 by 100 feet. Colors and reflectances are as follows: white ceiling, 70%; yellow walls, 55%; concrete floor, 40%; green dado, 12%; light gray machine frames, 35%.

INSTALLATION: General illumination is provided by 232 industrial fluorescent luminaires (Day-Brite Lighting, Inc., catalog No. RS-40281 NB) mounted 14 feet from the floor in 10 rows of 22 and one row of 12, spaced 9 feet apart. Each luminaire is 4 feet long and equipped with two 40-watt T-12 standard cool white preheat starter type fluorescent lamps. The average general illumination is 50 footcandles. Brightnesses are as follows:

Ceiling	6.15 ft-L	Luminaire	
Walls	12.3 ft-L	Longitudinal at 45°	380 ft-L
Floor	8.9 ft-L	Longitudinal at 30°	379 ft-L
Dado	2.0 ft-L	Crosswise at 30°	380 ft-L
Machine Frames	9.0 ft-L		

Lighting designed by William G. Speed, Lighting Specialist, Hopkin Bros., 120 North 7th St., Philadelphia, Pa.; Installation by Masland Duraleather Operating Maintenance Department, Edwin S. Marshall, electrical engineer in charge.

Lighting data submitted by Richard D. Kindt and George T. Anderson, Jr., Lighting Engineers, Philadelphia Electric Co., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

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A.I.A. File No. 31-f

Here and There with I.E.S. Members

The story of lighting the White House is told in the I.E.S. booklet prepared by Dr. S. G. Hibben (right), I.E.S. Past-President and Chairman of the Historical Committee. The booklet was presented, by I.E.S. President R. F. Hartenstein (left) to Homer Gruenther, a member of President Eisenhower's staff of executive assistants, during the East Central Regional Conference, which was held in Washington. The illustrated book contains the nation's first planned-lighting specifications, prepared for President James K. Polk and his official family. It has been passed to Mrs. Eisenhower for the White House archives.

Certificate of Merit for safety is presented to I.E.S. Fellow Oscar P. Cleaver (right), chief of the Electrical Engineering Department of the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va. The Department received the certificate for establishing an accident-free year under relatively hazardous conditions and also for sponsoring a most outstanding safety program. Major General David H. Tulley, Commanding General, is making the presentation.

I.E.S. Residence Lighting Committee meets at the National Housing Center, Washington. Left to right around table: Mary Taepke, Elizabeth Meehan, Ted Cox, Committee Chairman Frank Marriett, Jan Reynolds, E. W. Halteman, Arnold Wasserman, Myrtle Fahsbender, Kaye Leighton; in front of table, Mary Dodds and I.E.S. Technical Director C. L. Crouch.

LIGHTING NEWS

Ten New Fellows Elected

Unanimous favorable letter ballot of Council, acting on the recommendation of the Board of Fellows, has elected ten distinguished members of I.E.S. to Fellow Grade. This action, taken at the June meeting of Council, elects the following Fellows:

Earl A. Anderson, Manager, Michigan Sales District, General Electric Company, Detroit, Michigan. Mr. Anderson, long a member of I.E.S. (elected 1915), is the "other half" of the famous Harrison-Anderson collaboration whose studies gave to illuminating engineering the first authoritative determination of coefficients of utilization. Their work, classics in the field of illumination, was published in the *I.E.S. Transactions* in 1916 and 1920. Mr. Anderson is credited, also in collaboration with Ward Harrison, with the revolutionary RLM Standard Dome development; the first accurate reflection tests of colored surfaces, glare effect experiments, and early industrial production tests. He is, of course, the author or co-author of numerous basic papers in illuminating engineering, many of them in the *I.E.S. Transactions*. Mr. Anderson's studies in street lighting during the Twenties also represent significant steps in the science of illuminating engineering. His studies on illumination and traffic accidents, street lighting and the incidence of crime, and similar work were, and still are, basic works in this field.

Eric H. Church, Vice-President and Production Manager of Lighting Products, Inc., Highland Park, Illinois. Mr. Church's work with many technical committees of I.E.S., as well as his long association with research and development work in lighting, has contributed significantly to progress in the lighting industry. His analytical approach to illuminating engineering has been evident in many of his original studies in illumination. Best known, and probably most widely applied are his published works on "The X-Factors in Fluorescent Lighting"; "The Effects of Luminous Ceiling Elements on Visibility"; basic studies in acoustics, plastics, ballast design and lighting maintenance, and numerous other papers. Mr. Church's practical approach to technical problems has benefited the work of many I.E.S. committees of which he has been member and/or chairman. An outstanding example, though only one of many, is his development and production of the "Dirt-O-Meter," a device developed under his guidance as chairman of the Lighting Maintenance Committee. This was the first practical equipment developed for the measurement of dirt accumulation for the purpose of maintenance studies. Mr. Church's wide interest in many phases of illumination is exemplified in the variety of his committee assignments also. His membership and chairmanship of I.E.S. committees has ranged from the Testing Procedures Committee, Brightness Measurements for Illumination Characteristics, Committee on Plastics in Lighting, as examples, through work also with such committees as the Publications Committee, Sustaining Membership committee, and MMILJ Contest, to name a few. Currently he is Chairman of the Chicago Section, Chairman of the ommittee on Light Control and Equipment Design, and Midwestern Regional Publications Representative.

George Franklin Dean, Supervising Engineer, Lighting Service Section, Toronto Hydro Electric System, Toronto, Ontario, Canada. One of Canada's foremost illuminating engineers, Mr. Dean is also widely known in the United States, through his extraordinary service to I.E.S. Currently a Director of the Society, member of Council, and Chairman of the Committee on Constitution and By-Laws, Mr. Dean has served in literally scores of other I.E.S. assignments. He was an early officer of the Toronto Chapter, and was instrumental in its growth to Section status. He served nationally as Regional Vice-President for Canada beginning in 1949, during which term he contributed much to the organization of a Chapter in Winnipeg, as well as working closely with other Canadian Sections and Chapters.

Mr. Dean's career in lighting is also a distinguished one. A popular lecturer on many phases of illumination, he is the author of numerous technical papers in the Canadian trade press. Through programs originated by Mr. Dean, relighting in Toronto schools is now being made to I.E.S. standards; banking institutions of Toronto have adopted a 30-footcandle minimum standard; seeing requirements in his city's largest newspaper building are being studied. He has supervised a survey of over 1000 classrooms in Toronto. This city now enjoys the reputation of being one of the most progressive in school lighting practice.

Mr. Dean has long been an active member also of the Canadian Engineering Standards Association (Canadian equivalent of ASA) and a member of many of their committees. Currently he is Chairman of the joint committee of the Canadian Electrical Association and the Canadian Standards Association leading to the adoption of a Canadian Standard of Industrial Lighting, School Lighting and Street and Highway Lighting, based on the IES-ASA standards in these fields.

Gilbert K. Hardacre, Manager, Sales Promotion, Commonwealth Edison Company, Joliet, Illinois. Mr. Hardacre first gained renown as a Street Lighting Engineer, an interest he has retained throughout numerous other lighting activities and interests. In that field he assisted in the development of the American Standard Practice of Street Lighting, and was a well-known speaker on the subject, and author of numerous papers. His activity with I.E.S. is, of course, as long standing as it is well known. Serving nationally as President of I.E.S. (1946-1947), he has also contributed his organizational and technical talents to scores of committees over the years, as well as active participation in the I.C.I. Within the industry, Mr. Hardacre is also well known and well appreciated for his work with NEMA committees, several of which he has served as chairman, and with the Chicago Lighting Institute, as member and President. As a distinguished leader in the

Earl A. Anderson | Eric H. Church | George Franklin Dean | Gilbert K. Hardacre | George A. Horton

lighting industry, he has been several times honored with industry awards. In 1932 he was winner of the James M. Gilchrist Award, highest honor conferred by the National Electric Lighting Association. The following year, in 1933, Mr. Hardacre was awarded second prize for the James E. Davidson Award, by the Edison Electric Institute.

George A. Horton, Engineering Section Manager, Engineering Laboratories, Westinghouse Electric Corporation, Cleveland, Ohio. Mr. Horton's outstanding work in the important sciences of photometry, instrumentation and testing procedure has earned for him much distinction in illuminating engineering, and in optical circles as well. His development of a telescopic visibility meter for the evaluation of street lighting is widely recognized as a major achievement in instrumentation. Details of this development were published in his 1951 Conference paper (ILLUMINATING ENGINEERING, September 1951), first presented at the Washington Conference. Many an engineer is indebted to Mr. Horton, also, for his application of IBM punched card equipment (formerly of interest to accountants only) to scientific problems, particularly to the calculation of illumination and photometric quantities. With this development, tedious illumination calculations were reduced, accuracy increased, and engineering manpower greatly conserved. Currently Mr. Horton is developing the IBM Digital Encoding device for use on photometers, so that photometric readings may be punched directly into tape or IBM cards without manual transcription of data.

Mr. Horton is the originator of a laboratory method of measuring brightness of fluorescent luminaires to give correct and logical evaluation of maximum brightness values. As with his other work, this development also is a basic reference in the literature, published in ILLUMINATING ENGINEERING.

An active member or chairman of many I.E.S. technical committees, Mr. Horton is at present Chairman of several subcommittees of the Committee on Testing Procedures for Illumination Characteristics, which committee he has also served as chairman, and is Chairman of Technical Committee 1.2, Photometry, Physical and Visual, of the Commission Internationale de l'Eclairage.

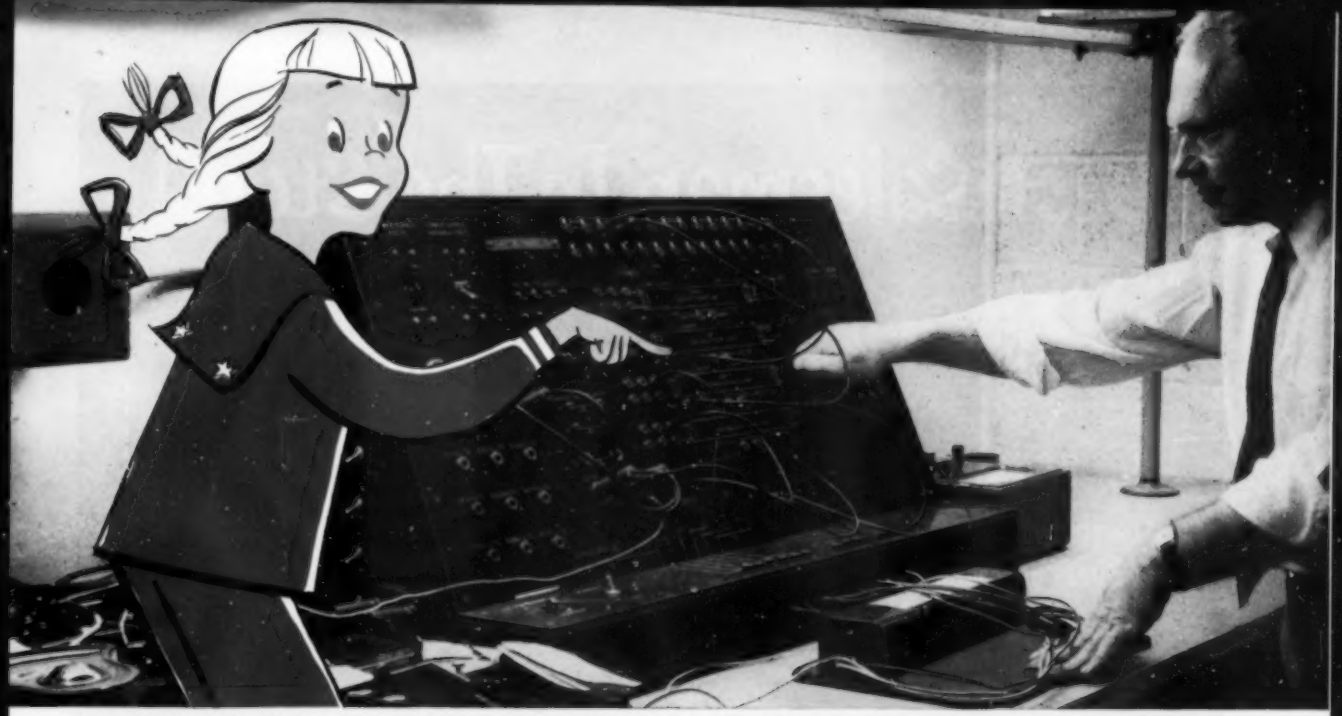
Bruce J. Jensen, Assistant Manager of Commercial Sales, Public Service Electric and Gas Company, Newark, New Jersey. Mr. Jensen's contributions to illuminating engineering are numerous, but have been of especial value to the field of outdoor lighting. He has originated many application techniques, and has been the designer of numerous equipments in street lighting, floodlighting, tunnel and underpasses, and other outdoor lighting applications. Lighting for the first highway cloverleaf was designed by Mr. Jensen. In this connection he developed unique celluloid "patterns" of light distribution on the roadway, which were subsequently used for designing and lighting for highway circles, viaducts, and ramps throughout the State. Modernized templets of this type are still in use.

During the War, Mr. Jensen was Blackout and Dimout Coordinator for the State of New Jersey, attached to the staff of Leonard Dreyfuss, State Civilian Defense Director. In this capacity Mr. Jensen worked closely with the United States Army and Civilian Defense authorities in formulating practical plans for dimout, and the education of men at local levels to carry out these plans.

Throughout the years Mr. Jensen has worked closely with the New Jersey State Highway Department, which has relied upon him continuously, in the development of its highway lighting and sign lighting programs.

(Continued on page 13A)

Bruce J. Jenson | Charles N. Laupp | Dorothy Nickerson | Gwilym F. Prideaux | Marshall N. Waterman



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*Miss Fluorescent Ballast, G.E.'s ballast mascot.

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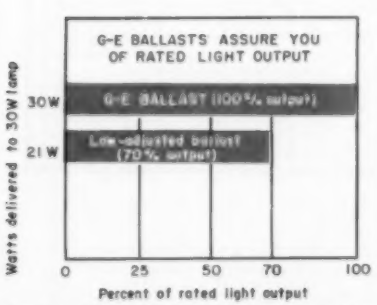

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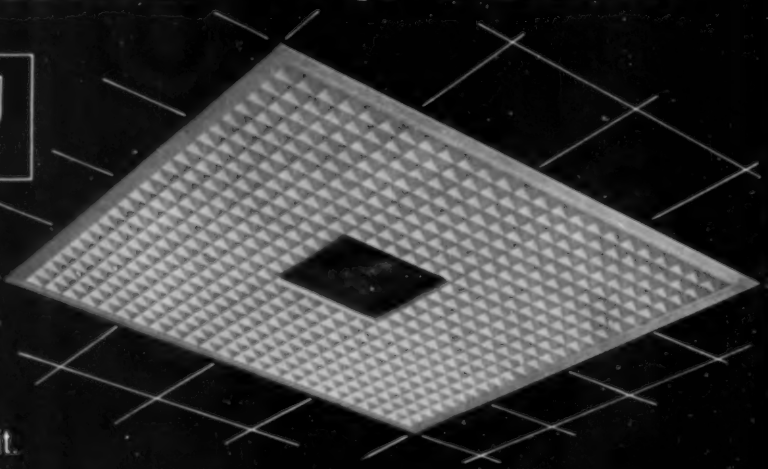


An outstanding unit, combining incandescent light to high-light merchandise with sparkle and warmth—and a high-level of well-diffused fluorescent light for comfortable overall seeing. Hinged, one-piece aluminum louver offers maximum rigidity, minimum weight. Can't come apart, can't sag. Utilizes six or eight 48" Rapid-Start fluorescent lamps and one 200 or 300 watt incandescent lamp directly above a glass lens in the center of the egg-crate type louver.

SPECIAL—Unique Alzak* aluminum reflector controls and blends fluorescent and incandescent light. No spash of incandescent . . . no contrast of fluorescent and incandescent colors on surface of fixture.

*T.M. Aluminum Company of America

Above: Garcy No. RS9700 units installed in John Wanamaker's, Wynnewood, Pennsylvania

GARCY 5600 LUMINAIRES FOR LUXURY LIGHTING

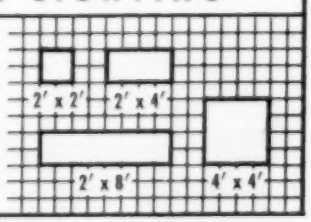
Available with THREE TYPES OF SHIELDING

Plastic panel in hinged frame
Hinged one-piece louver
Glass panel in hinged frame

VARIETY IN SIZE AND NUMBER OF LAMPS

2′ x 2′—Two, three or four lamp rows
2′ x 4′—Two, three or four lamp rows
2′ x 8′—Two, three or four lamp rows
4′ x 4′—Six, eight or ten lamp rows

Choice of rapid start fluorescent or slimline lamps



Send for Bulletin—552 L

GARCY Quality by *Design*

Garden City Plating & Mfg. Co., 1760 N. Ashland Ave., Chicago 22, Illinois
In Canada: Garcy Co. of Canada, Ltd., 1244 Dufferin Street, Toronto 4

(*Continued from page* 10A)

A member of I.E.S. for nearly thirty years, Mr. Jensen has been active on many of its committees, nationally and locally. In 1944-45, he served as Chairman of the New York Section, and has ever been an active contributor to Section projects. One of many major contributions to the Society's program was his outstanding work as Chairman of the Handbook Revision Committee during 1949 through 1952. A project of enormous scope, the revision of the I.E.S. Lighting Handbook was brought to successful production under Mr. Jensen's leadership. Currently he is an active member of the Committee on Advance Planning, and the Medal Award Committee.

Charles N. Laupp, Illuminating Engineer, Wisconsin Electric Power Company, Milwaukee, Wisconsin. Mr. Laupp, a Registered Professional Engineer, and 1946 winner of the Niagara Award, is almost as well known to municipal authorities in his area, as he is by lighting people throughout the country. To serve them in their needs for counsel in illuminating engineering, the Milwaukee Public School Board, and the Milwaukee Vocational School Board appointed Mr. Laupp, in 1952, to their Lighting Fixture Rating Committee. In this capacity, he provides guidance to the school boards on classroom lighting. His renown as a speaker on lighting practice has brought him before a wide variety of audiences: safety engineers, industrial groups, architects, school officials, sanitary engineers and many others.

Mr. Laupp's talents as an engineer have, of course, been in much demand for service on I.E.S. technical and other committees. He was for many years a member of the School Lighting Committee, and has served also on committees for Lighting Education, Light Control and Equipment Design, Constitution and By-Laws, Papers Committee, and Lighting Service Committee, as well as serving locally as Chairman of his Section and Regional V-P for the Midwest. Currently he is national chairman of the National Technical Conference Committee.

Dorothy Nickerson, Color Technologist, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C. Many direct contributions to illuminating engineering, and many more to colorimetry, have brought to Miss Nickerson eminence in both fields. Her work in color technology, much of it published in the I.E.S. Transactions, has been of great value to the illuminating profession. Outstanding, and perhaps best known to illuminating engineers, are her studies leading to proper illuminants for color matching and discrimination, artificial lighting for cotton classing, artificial "daylighting" studies, illuminants for textile color matching, Munsell color specifications for different illuminants, and many others. Reference literature in ILLUMINATING ENGINEERING contains some nine technical papers by Miss Nickerson, with as many more published in the journals of the Optical Society and other technical publications. Miss Nickerson holds a patent on apparatus for measuring color, which she developed in 1933. In 1951 she was awarded the Department of Agriculture Superior Service Award for her outstanding work.

Miss Nickerson is as active in the Inter-Society Color Council, as she is in I.E.S., serving that Society as Secretary from 1938 through 1952, and as their President in 1954-1955. In I.E.S. work, she is a valuable member of the Subcommittee on Color Rendition of IES Committee on Light Sources, and over the years has served on numerous other technical committees. Active too, in Capital Section affairs, she was Chairman of that Section, 1954-1955, and has been a member of its Board of Managers for many years.

Applications for Retired Membership

By action of the membership, the new retired membership classifications will become effective in the new fiscal year, beginning October 1, 1956. Privileges in these new grades, earned by long membership in the Society, include reduced annual dues ($5) with continued receipt of all Society mailings including the monthly Journal, ILLUMINATING ENGINEERING. Such members will be designated as Member, Retired; Associate Member, Retired; etc. Those who are interested and qualified (at last thirty years of membership and 65 years of age) should address a letter to the General Secretary at Headquarters, stating that they have retired from regular occupation in business or profession.

Gwilym F. Prideaux, Illuminating Engineer, General Electric Company, Nela Park, Cleveland, Ohio. It would probably be no exaggeration to designate Mr. Prideaux as one of the world's foremost authorities on miniature lamps. He was instrumental in the devolpment almost every type of miniature lamp now in use, from radio panel, automotive, flashlight, to name a few, to the familia- photoflood lamps used for indoor photography. In 1933 he received the Charles A. Coffin Award for his originality and initiative in developing and making commercially practicable the Mazda Photoflood lamp. It was he who actively promoted back in 1925, the idea of miniature cameras. He interested the Agfa Ansco Company in this idea, and their Memo Camera and Memoscope projector were the first such commercial items in America. No less than six patents have been granted to him for original devices in the miniature lamp field. It was, of course, only natural that the I.E.S. should turn to Mr. Prideaux for the major part of the preparation of the Miniature Lamp Section of the *IES Lighting Handbook*, and for the compilation of Miniature Lamp History in the Fiftieth Anniversary Issue (January, 1956) of ILLUMINATING ENGINEERING.

During 1950, Mr. Prideaux was instrumental in organizing the I.E.S. Committee on Mine Lighting, serving as its first chairman in 1951-1952. Work of this committee is expected to furnish still further progress in lighting knowledge, with Mr. Prideaux continuing as one of its leading members.

Marshall N. Waterman, Assistant Manager, Commercial Engineering Dept., Westinghouse Electric Corporation, Bloomfield, New Jersey. Mr. Waterman's leadership in I.E.S. has led to his election, for this current year, as President of the Illuminating Engineering Society. Extraordinarily valuable contributions to technical progress in lighting, however, have led to his election as a Fellow. Mr. Waterman is one of the early experimenters on the application of mercury vapor lamps. One of his reports on these studies, in which these sources were used for the illumination of tennis courts, established the stroboscopic effect on play, and furnished the basic data for the NEMA Sports Lighting Committee recommendations.

Mr. Waterman is the originator of several well-known lighting techniques. While in charge of lighting application at the Central Hudson Gas and Electric Corp., Poughkeepsie, N. Y., he designed one of the earliest systems (1940) em-

(*Continued on page* 16A)

NEW
INDUSTRIAL INCANDESCENTS

DETACHABLE

Mounting and socket assembly easily attached and wired as a complete unit. Reflector attaches without tools or handling of loose parts.

SIMPLE TO INSTALL —

Detachable: The small lightweight mounting and socket assembly, oversize wireways and large exposed terminal screws are designed for maximum economy of installation. Reflectors are easily detachable without use of tools for floor-level cleaning.

TOP QUALITY

Detachable: Die-cast housing and clamping ring with gripping fins for easy hand tightening. Reflector is supported by the mounting assembly with no strain on the socket.

MILLER PATENTED

For both Detachable —

- Center contact spring-loaded for continuing positive connection (spring does not carry any current).
- Mogul sockets are ventilated to prevent lamp from "freezing" in the socket.

REFLECTOR

For both Detachable —

- **Louvred Ventilation:** to protect the lamp from dripping moisture.
- **White Porcelain Enamel Finish:** *White** to comply with current trend to a lighter environment. *Porcelain enamel* insures long life, easy cleaning.

*Green on special order when required or to match existing installations.

YOUR MILLER DISTRIBUTOR OR MILLER REPRESENTATIVE WILL GLADLY CALL AND DEMONSTRATE THESE AND MANY OTHER FEATURES — OR WRITE FOR CATALOG IN-5

BY miller

- LOUVERED FOR VENTILATION
- ALL-WHITE REFLECTORS
- TWO MOUNTING TYPES

— EASY TO MAINTAIN

Disconnect: For owners and contractors alike, the rugged yet simple construction means lower installation costs and convenience of maintenance. Oversize wireways, jumbo terminal screws, open-faced terminal blocks and positive locking action are features of Miller's new disconnect design.

CONSTRUCTION

Disconnect: Porcelain contact block snaps out for easy wiring. Recessed circular contacts maintain polarity. Barrier type design guards against shorting when reinstalling reflector. Three heavy-duty stainless steel lugs engage heavy steel bayonet ring for positive connection.

SOCKET FEATURES

— and Disconnect

- UL, AFL-IBEW labels.
- Precision balanced shock absorber springs optional to prolong lamp life in vibration conditions.
- Available in pendant, outlet box and side entry types.

DISCONNECT

Mounting and socket contact assembly easily connects or disconnect via 3 bayonet slots engaging heavy-duty lugs in mounting assembly.

FEATURES

— and Disconnect

- **Interchangeable:** *Disconnect* reflectors completely interchangeable by wattage and reflector types. *Detachable* medium-base reflectors and mogul-base reflectors can be interchanged.
- **Variety of Types:** RLM Standard Dome • Shallow Dome • Standard Angle • Elliptical Angle • Silver Bowl Dome • RLM Glassteel • Porcelain High Bay • Aluminum High Bay

miller

Better Lighting for a Brighter America©

THE MILLER COMPANY • GENERAL OFFICES: MERIDEN, CONN. • FACTORIES: UTICA, OHIO—MERIDEN, CONN. • IN CANADA: CURTIS LIGHTING OF CANADA LTD., TORONTO

(*Continued from page 13A*)

ploying fluorescent lamps in combination with incandescent. He designed and made working models of three-ring louver devices to be used in coffers, a familiar technique now. Several of Mr. Waterman's original application papers were presented before National Technical Conferences of I.E.S., and published in the Society's journal.

In addition to his national, local and committee service with I.E.S., Mr. Waterman has been representative to the ASA Committee Z-55, Colors for Industrial Apparatus and Equipment, a representative to CIE, and a member of the AIEE Executive Committee Illumination Division, New York Section. He is at present a Consultant to the National Society for the Prevention of Blindness, a member of AIEE National Committee on Production and Application of Light, and, of course, President-Elect of I.E.S.

Operation I.E.S.

The National Technical Conference—How it is Planned

This issue of ILLUMINATING ENGINEERING comes out as we hold our Annual Technical Conference, this year in Boston. The 1956 Conference marks the Fiftieth Anniversary of the Society. As in other years, it also presents some 30 outstanding technical papers, for our advancement in the art of illumination.

Since this is "Conference" month for us, it is fitting that we consider the procedure followed in organizing for and putting on our Technical Conferences.

Council selects the location of National Conferences, from recommendations made by the National Technical Conference Committee. This recommendation is based on a study of invitations or "bids" from Sections and Chapters. A Section wishing to be host to a future Conference (they are scheduled about three years in advance) sends its invitation to the chairman of the National Technical Conference. With this invitation they usually include written assurance of suitable hotel accommodations for the dates involved, and other exhibits to indicate the suitability of the site.

In making recommendations to Council for the time and place of a National Technical Conference, the committee is guided as far as possible by the following:

(a) Adequate hotel, meeting room and transportation facilities.

(b) The necessity of rotating the annual Conference in Regions and Sections on the North American Continent in which the membership is well established and locations which will as a rule adequately serve the largest numbers of members at the lowest traveling and overall expense.

(c) Providing proper balance between National Technical Conferences in large cities and in suitable resort areas.

(d) If not inconsistent with the above, locations where the stimulus from a National Technical Conference will greatly benefit the Region and thus the Society.

The scheduling of Conferences has become more difficult as our Society grows in membership. We have been getting attendance of around 1000 people at our Conferences. Hotel facilities to house such crowds are becoming increasingly difficult. As a result, the Conference Committee has made commitments for locations and hotels for several years in advance. As a matter of interest, the next three Conferences to follow are: Atlanta, 1957; Toronto, 1958; San Francisco, 1959.

The National Technical Conference Committee includes as ex-officio members the following:

Chairman, Papers Committee,
Chairman, Lighting Service Committee,
Chairman, Finance Committee,
Chairman, National Technical Conference Executive Committee,
Regional Vice-President of the Region in which the Conference is scheduled,
Executive Secretary of I.E.S.

The National Technical Conference Committee is completely responsible, subject to the approval of Council, for the general coordination of all conference activities, for selecting and recommending time and place, for review and approval of the plans and budgets of the Conference Executive Committee and, in cooperation with the Papers Committee, for the satisfactory time allocation to the Technical Papers Sessions.

When a Region, Section or Chapter acts as a host for the National Technical Conference, it forms a committee to be known as the National Technical Conference Executive Committee. This Executive Committee organizes such subcommittees as may be required to handle the details of the National Technical Conference. The National Technical Conference Executive Committee confers frequently with the national committee, and makes detailed reports on the progress of its plans and proposed expenditures.

National Technical Conferences must be planned to be self-supporting. Conference fees charged to members, to their wives, and to other guests to cover costs, are determined by the National Technical Conference Committee and are reviewed for specific approval by Council at a regular or special meeting.

The National Technical Conferences are guaranteed financially by the Society. Budget is prepared by the Conference Executive Committee and submitted to the National Technical Conference Committee and to the Finance Committee for review, and then submitted for final approval by Council. No payment of any Society funds other than those items included and authorized in the budget, or subsequently added to the budget by Council, can be made for Conference expenses.

The Society discourages special entertainment features or other courtesies sponsored by commercial interests at the National Technical Conference. Plans for all such proposed gatherings or parties or any other company-sponsored feature must be submitted in advance to the National Technical Conference Committee with full details, for their review. If approved by this committee, they must then have specific approval of Council.

It has been nice writing to you about our Society during the past year as your General Secretary. We appreciate the replies we have received from those who said they read our short articles. Good luck to you all. GEORGE J. TAYLOR, *General Secretary.*

NBS To Relocate Its Washington Laboratories

A tract of approximately 550 acres of land near Gaithersburg, Maryland, has been selected for relocation of the Washington laboratories of the National Bureau of Standards. The move will permit the Bureau to plan new buildings to replace present research facilities, which over the past 50 years have become inadequate for current needs.

The new site was selected after careful consideration as most suited to the special requirements of the Bureau's scientific and engineering programs. The choice was based upon a number of factors, including accessibility by railroad

(*Continued on page 19A*)

Perfeclite now offers a new **hammer lock** design in incandescent ceiling pan lighting fixtures. No other ceiling pan fixture on the market today has all these engineering features:

- Globe opens on **hinge** for quick easy cleaning and relamping.
- Unique **safety locking fitter** holds globe in place without bothersome screws, unsightly extensions or trick springs. Globe is secured with lugs by simple twist of the wrist.
- Lip of globe is completely protected against breakage by a **steel protector ring.**
- Provides **ceiling illumination** as well as **evenly distributed floor lighting.**
- Minimum amount of metal, maximum amount of glass results in **highest light efficiency.**

Here is a unique ceiling pan fixture design for either commercial or residential installation. For further information fill in and mail the attached coupon today.

Perfeclite's new **hammer lock** fixture is available in the following sizes:

Model	Glass Diameter	Wattage
HH-9	8″	2- 40 W
HH-11	10″	2- 60 W
HH-13	12″	2- 75 W
HH-15	14″	2-100 W
HH-17	16″	3-100 W

SUSTAINING MEMBER

Fixtures are Underwriters Laboratories, Inc. approved.

*Patent pending

THE PERFECLITE COMPANY

1457 East 40th Street • Cleveland 3, Ohio

Gentlemen:

Please send me The Perfeclite Data Sheet 56-C

Name.....

Address.....

City.....State.....

PERFECLITE PRODUCTS — THE MARK OF LIGHTING SERVICE

Sylvania's VHO lamp makes possible more light per foot from fluorescent lamps

Produces more than twice the light output of conventional 40 watt lamps!

Sylvania Research conquers Heat and Pressure—two major obstacles to more light per foot!

The VHO-lamp represents an entirely new concept in lamp design—an entirely new way to get more light per foot from fluorescent lamps.

To make this achievement possible Sylvania engineers have developed and combined these vital features:

1. New "Pressure Control" Center. The specially developed, exclusive internal end construction of the VHO lamp creates "cool spots" at each end which allow mercury to condense.

2. Neon gas replaces Argon. Sylvania discovered that Neon actually gives far greater efficiency at higher wattages than the conventional Argon.

3. Use of standard T-12 bulb. The popular T-12 bulb permits maximum effective production and use of ultraviolet radiation within the tube.

4. The Patented Sylvania Rapid Start System. This development for fluorescent lamps keeps filaments warm during operation of lamp, and encourages effective electronic emission from filaments at all times.

IN APPEARANCE, the VHO-25 is a standard 4-foot T-12 lamp, yet it produces *more than double* the light output of 40-watt fluorescent lamps made until now.

Due to the substantially greater light output of the Sylvania VHO, High-Bay Industrial Fluorescent lighting becomes practical and economical. In Low Bay lighting, VHO lamps will, in many cases, prove more economical because fewer fixtures are required.

VHO lamps are also a new and practical answer to better, highly efficient street lighting . . . use a minimum of lighting units of less cumbersome size. They are also particularly suitable for other outdoor lighting applications such as store fronts, service stations, and floodlighting of outdoor industrial or commercial areas.

If you are considering plans which include lighting for new construction or modernization, the new Sylvania VHO fluorescent lamp will be of particular interest to you. For complete details consult your local Sylvania Representative, or send today for your free folder about the revolutionary Sylvania VHO Rapid Start Fluorescent Lamp. Write to:

SYLVANIA ELECTRIC PRODUCTS INC.
Lighting Division, Dept. I, Salem, Mass.
In Canada: Sylvania Electric Products (Canada) Ltd.
Shell Tower Building, Montreal

SYLVANIA

. . . fastest growing name in sight

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

(*Continued from page* 16A)

and highway as well as topography for certain technical projects.

The Congress appropriated funds for site acquisition and preliminary planning early in June after details about the proposed site had been presented to House and Senate Appropriations Committees. Plans for the site have been given to the National Capital Planning Commission and to the Regional Planning Council, and it is expected that these groups will work with the Bureau in utilizing the land. The General Services Administration will participate in planning and will supervise construction. Transfer of operations to the new location is expected to be completed in about five years.

The Bureau has occupied its present site on Connecticut Avenue since 1903. During that time its responsibilities have greatly increased, largely as a result of the rapid expansion of technology and the growth of scientific research. Extensive programs of research and development must now be conducted in the physical sciences and engineering to provide new and improved standards and measurement methods.

It is expected that the new location will make possible a more modern research operation in structures that can be efficiently managed. In addition, the new site will provide the benefits of a rural location where scientific programs can be undertaken without interfering in community life and without urban interference to important Bureau projects. The location will remove the Bureau's work from the variety of mechanical, electrical and atmospheric disturbances present in a city and will reduce the effect of these forces upon precise scientific measurements.

Gold Medal Nominations Due January 1

According to official I.E.S. Procedure, nominations for the I.E.S. Gold Medal Award, for consideration by the 1956-1957 committee, must be received at the headquarters office by January 1.

Nominees for the award need not be members of the Society, nor citizens of the United States or Canada, and may be nominated at any time by any member of the Society, by presenting to the General Secretary the name of the individual whose accomplishments in his field are deemed worthy of such recognition. This field may be engineering, design, applied illumination, optics, ophthalmology, light-

(*Continued on page* 20A)

SCHEDULED EVENTS

1956

September 25-26, 1956 — Producers' Council, Inc., 35th Annual Fall Meeting and Chapter Presidents' Conference, Wade Park Manor Hotel, Cleveland, Ohio.

October 1-5, 1956 — American Institute of Electrical Engineers, Fall General Meeting, Morrison Hotel, Chicago, Ill.

October 2-4, 1956—Canadian Electrical Manufacturers Association, 12th Annual Meeting, Sheraton Brock Hotel, Niagara Falls, Ontario, Canada.

October 7-12, 1956 — Society of Motion Picture and Television Engineers, Ambassador Hotel, Los Angeles, Calif.

October 15-16, 1956 — United States Committee, International Commission on Illumination, Nittany Lion Inn, State College, Pa.

October 18-20, 1956 — Optical Society of America, Lake Placid, N. Y.

October 22-24, 1956 — American Standards Association, 38th Annual Meeting (In conjunction with Seventh National Conference on Standards), Hotel Roosevelt, New York, N. Y.

October 22-26, 1956 — National Safety Council, 44th National Safety Congress & Exposition, Chicago, Ill.

November 12-16, 1956 — National Electrical Manufacturers Association, Annual Meeting, Traymore Hotel, Atlantic City, N. J.

1957

January 21-25, 1957 — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

January 28-31, 1957 — Plant Maintenance & Engineering Conference, Cleveland, Ohio.

February 17-20, 1957 — National Electric Sign Association, Annual Convention and Exhibit, Sheraton Park Hotel, Washington, D. C.

February 25-28, 1957 — American Society of Heating and Air-Conditioning Engineers, 63rd Annual Meeting, Chicago, Ill.

February 25 - March 1, 1957 — 13th International Heating and Air-Conditioning Exposition, Chicago, Ill.

March 11-14, 1957 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

March 28-29, 1957 — Pacific Northwest Regional Conference, Illuminating Engineering Society, Empress Hotel, Victoria, B. C.

April 3-5, 1957 — South Pacific Coast Regional Conference, Illuminating Engineering Society, Hotel Statler, Los Angeles, Calif.

April 8-11, 1957 — Fourth National Electrical Industries Show, 71st Regiment Armory, New York, N. Y.

April 11-12, 1957 — Inter-Mountain Regional Conference, Illuminating Engineering Society, Hilton Hotel, Albuquerque, N. M.

April 28-30, 1957 — Southwestern Regional Conference, Illuminating Engineering Society, Holiday Inn, Oklahoma City, Okla.

April 28 - May 3, 1957 — Society of Motion Picture and Television Engineers, Shoreham Hotel, Washington, D. C.

May 6-8, 1957 — Air Conditioning and Refrigeration Institute, Annual Meeting, The Homestead, Hot Springs, Va.

May 9-10, 1957 — Midwestern Regional Conference, Illuminating Engineering Society, Hotel Astor, Milwaukee, Wis.

May 13-14, 1957 — Great Lakes Regional Conference, Illuminating Engineering Society, Pantlind Hotel, Grand Rapids, Mich.

May 16-17, 1957 — Canadian Regional Conference, Illuminating Engineering Society, Hotel Sheraton Brock, Niagara Falls, Ont.

May 23-24, 1957 — East Central Regional Conference, Illuminating Engineering Society, William Penn Hotel, Pittsburgh, Pa.

June 4-6, 1957 — Chicago Electrical Industry Show, Conrad Hilton Hotel, Chicago, Ill.

June 12-13, 1957 — Northeastern Regional Conference, Illuminating Engineering Society, Hotel Statler, New York, N. Y.

June 24-28, 1957 — American Institute of Electrical Engineers, Summer General Meeting, Montreal, Que.

August 26-30, 1957 — American Institute of Electrical Engineers, Pacific General Meeting, Yakima, Wash.

September 9-13, 1957 — Illuminating Engineering Society, National Technical Conference, Biltmore Hotel, Atlanta, Ga.

October 6-11, 1957 — Society of Motion Picture and Television Engineers, Hotel Statler, New York, N. Y.

October 7-11, 1957 — American Institute of Electrical Engineers, Fall General Meeting, Chicago, Ill.

October 21-25, 1957 — National Safety Council, 45th National Safety Congress & Exposition, Chicago, Ill.

November 11-15, 1957 — National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, N. J.

November 18-21, 1957 — 10th Exposition of the Air-Conditioning and Refrigeration Industry, Navy Pier, Chicago, Ill.

I.E.S. National Technical Conferences

1956 — September 17-21 — Hotel Statler, Boston, Massachusetts

1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia

1958 — August 17-22 — Royal York Hotel, Toronto, Ontario

1959 — September 7-11 — Hotels Fairmount and Mark Hopkins, San Francisco, California

(*Continued from page 19A*)

ing research, education, or administration and management.

In order for a candidate to be considered for the award of a given year, a letter requesting his consideration shall be delivered to the General Office before January 1 of that year. Nominations and records from previous years, as reviewed and referred to the next year's committee by previous Medal Award Committees, will be given consideration along with new nominations.

The Gold Medal, the Society's highest award, is given "for the purpose of giving recognition to meritorious achievement which has conspicuously furthered the profession, art or knowledge of illuminating engineering." It is accompanied by an appropriate engrossed parchment certificate of award.

Recipients of the award since its establishment in 1944 have been: George H. Stickney, Preston S. Millar, E. C. Crittenden, Matthew Luckiesh, Sir Clifford Paterson, Ward Harrison, W. F. Little, H. H. Magdsick, E. F. Lowry and J. L. Stair. Recipient of the honor this year is Dr. George S. Crampton. No awards were made in 1951 and 1953.

New Trade Association Formed

A new trade association, the Cold Cathode Association, Inc. (C.C.A.), has been formed to promote the "technological advances of cold cathode lighting." At its opening meeting, Bert C. Pretzer, president of the Illuminating Engineering Company in Detroit, was elected president.

"Our aim," said Mr. Pretzer, "is to establish the best certification program possible for cold cathode lighting." Heretofore, Mr. Pretzer pointed out, qualifying standards have been violated with impunity with a resulting lowering of standards throughout the industry.

"We intend to issue our own label for certification," continued Mr. Pretzer. "This new label will be issued only to firms manufacturing cold cathode materials meeting the high specifications standards set forth by the C.C.A. in conjunction with a recognized public laboratory."

The By-Laws of C.C.A. stipulate that it will not indulge in sales promotion for its membership, that those misusing the C.C.A. label will be prosecuted, and that certification is open "to any individual or company meeting its requirements and specifications." Experience has shown that policing the use of such labels is the only way a high standard can be maintained. "It is not uncommon," Mr. Pretzer said, "to find a manufacturer buying labels from a certifying organization for a legitimately inspected product, only to fasten those labels on a completely different, untested and inferior product. This flagrant abuse of what is basically a good system must be prevented. The only successful way we know of preventing it is by means of a strict policing arrangement."

Another function of the association will be to disseminate educational material regarding cold cathode specifying procedures, applications and technical data among "architects, engineers, utility representatives and to all members of the consuming public either at cost, or, to the greatest extent possible, free of charge.

Other officers elected were:

Vice-President — Thomas Cortese, President of Colorescent Lighting, Inc., Elizabeth, N. J.

Secretary — Rudolph C. Hultgren, President of CELine, Inc., Batavia, Ill.

Treasurer — Victor H. Todd, President of the Swedish Iron and Steel Corp., Westfield, N. J.

(*Continued on page 23A*)

CAPITAL SECTION of I.E.S. brought its year to a close with the celebration of the Golden Anniversary. In photo above, Howard Sharp and Mrs. Ben Goodman are about to cut the birthday cake. In background are Harold Oerting, Ben Goodman and Mrs. Sam Charlesworth. In photo below left, C. E. O'Daniel happily shows the 50th Anniversary Pin which he won, making him the Section's representative to the Boston Conference. Below right, Section Chairman Ben Goodman receives a certificate of merit for his service to the group.

NEW INTERIORS FOR OLD

ECONOMICALLY AND QUICKLY WITH THE

Magic Ceiling

Have some of your customers longed to glamourize their place of business with a luminous ceiling but balked at the price? Listen to this. The Magic Ceiling can transform a place of business practically overnight—*at a cost that is pure magic.* There must be a reason of course—and there is. In fact there are several. Let's examine all this magic.

THE MAGIC CEILING is a stock item—a complete package of grid, channels, Wākon® diffuser, fluorescent lamps—delivered to your customer's place of business all ready to be installed on his present ceiling.

THE MAGIC CEILING comes in a series of standard sizes (see table at right) designed to fit practically any size or shape of room. You just select the size you need and "float" it in. Installation is a breeze.

THE MAGIC CEILING doesn't go wall-to-wall. Think of the savings in material, complicated engineering, time and labor this means. Visualize how it by-passes perimeter obstacles such as ducts, ventilators, shelving, etc.

THE MAGIC CEILING gives beautifully diffused light of at least 50 footcandles if installed on a reasonably white ceiling. It covers up the old unsightly ceiling, conceals pipes, ducts, sprinklers. And all this with no dirt, sawdust or plaster. No masons. No carpenters. An electrician does the complete installation.

FIVE POPULAR SIZES

Magic Ceiling Size	To Fit Room Approx.
9′ x 8′	10′ x 12′
9′ x 12′	12′ x 16′
12′ x 16′	16′ x 20′
15′ x 16′	18′ x 20′
18′ x 20′	22′ x 24′

Six other sizes available. See your Graybar man.

The Magic Ceiling is manufactured by Wakefield, a leader in lighting equipment for 50 years.

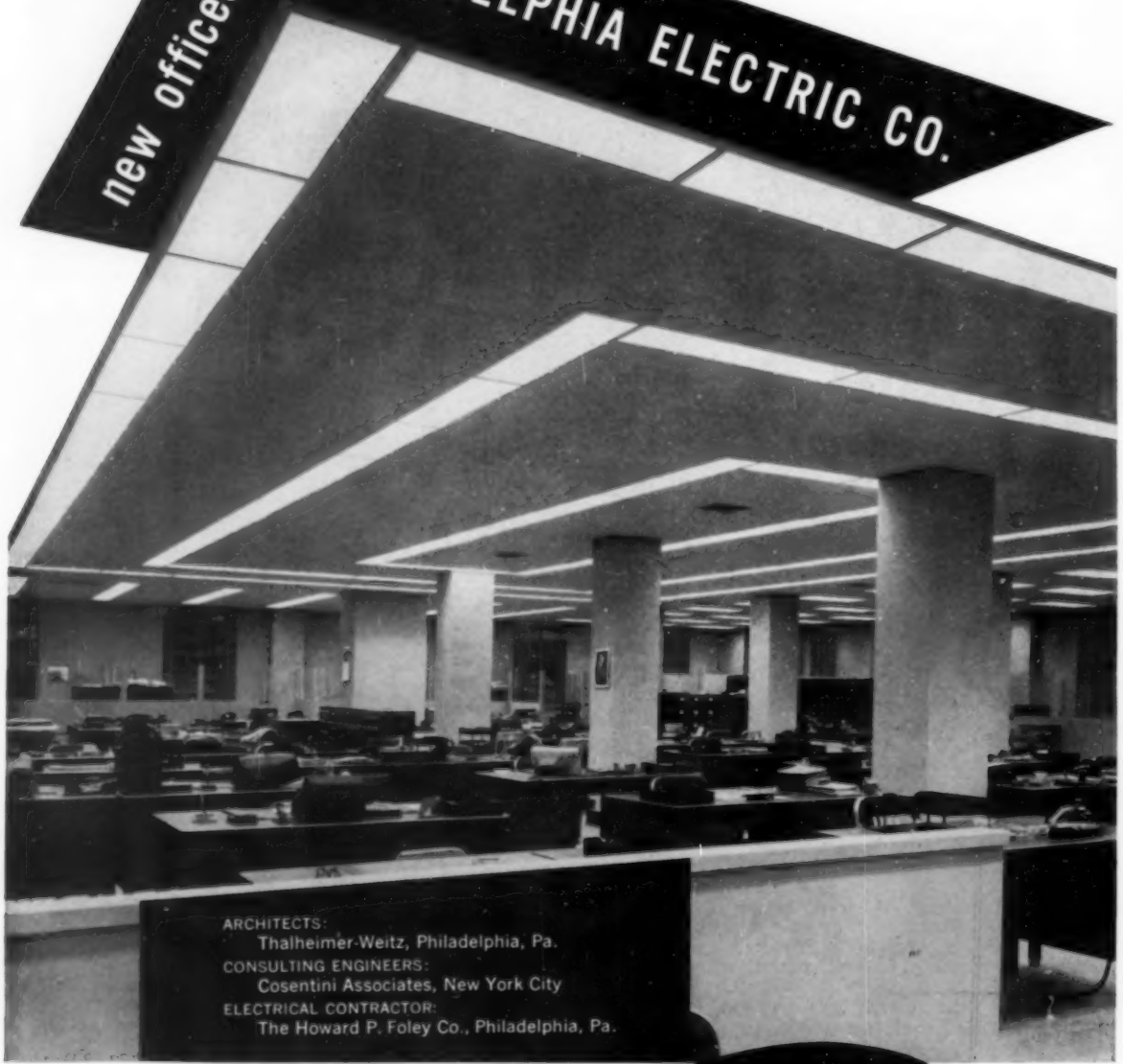
CALL GraybaR FIRST FOR

'GraybaR Everything Electrical 'GraybaR ELECTRIC COMPANY

GRAYBAR ELECTRIC COMPANY, INC., 420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

Offices and warehouses in more than 130 Principal Cities.

new offices for PHILADELPHIA ELECTRIC CO.



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ELECTRICAL CONTRACTOR:
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1957 Regional Conferences, I.E.S.

Region	Place	Date
Pacific Northwest	Empress Hotel Victoria, British Columbia	March 28-29
South Pacific Coast	Statler Hotel Los Angeles, California	April 3-5
Inter-Mountain	Hilton Hotel Albuquerque, New Mexico	April 11-12
Southwestern	Holiday Inn Oklahoma City, Oklahoma	April 28-30
Midwestern	Astor Hotel Milwaukee, Wisconsin	May 9-10
Great Lakes	Pantlind Hotel Grand Rapids, Michigan	May 13-14
Canadian	Sheraton Brock Hotel Niagara Falls, Ontario	May 16-17
East Central	William Penn Hotel Pittsburgh, Pennsylvania	May 23-24
Northeastern	Statler Hotel New York, New York	June 12-13

Scholarship Awards Announced At University of Illinois

The Faculty of the Illuminating Engineering Option of the Department of Electrical Enginering, University of Illinois, announces the scholarship awards for the second semester of 1955-1956, as authorized by the University Committee on Special Undergraduate Scholarships. These are:

Senior Scholarship — Chicago Section, Illuminating Engineering Society — to Robert Stephen Josepher, of Chicago.

Senior Scholarship — Holophane Company — to Bruce Everett Burgess, of Chicago; and Francis Henry Woolridge, of Findlay, Ill.

Junior Scholarship — Holophane Company — to Charles Lewis McAfee, of Springfield, Ill.

LC&ED Committee Holds Two-Day Meeting at Corning

Working to its objective, decided at a previous two-day meeting in March, of preparing a report to provide the basic information necessary for the design of control equipment for light sources, the Light Control and Equipment Design Committee met August 15 and 16 at Corning. The committee heard and reviewed the reports of the Subcommittee on Physics and the Subcommittee on Mathematics, and discussions were held on materials and luminaire design.

(Continued on page 58A)

Leonard J. Lewinson

Leonard J. Lewinson Retires ETL Pioneer

Leonard J. Lewinson, a member of I.E.S. since 1907, has retired from active service with the Electrical Testing Laboratories, Inc., New York City, but will continue as a Director of the company.

Mr. Lewinson joined the Laboratories in 1905 as Electrical Engineer in charge of Life Tests of Electric Lamps. He later became Co-Manager of Lamp Testing. In 1942 he was one of the original incorporators and Directors of Electrical Testing Laboratories, Inc. In 1949 he was made Manager, Special Lamp Services and, in 1953, Executive Vice-President.

During his career in the lighting industry, Mr. Lewinson has contributed to the Illuminating Engineering Society on both the national and local level. He was both a Manager of the New York Section and later Chairman, in 1924. During the 1920's he was for many years Chairman of the Board of Examiners. He has delivered several papers before I.E.S. Conferences, including one of the pioneer papers on measurement of natural illumination throughout the day.

LIGHT CONTROL and Equipment Design Committee at their two-day meeting at Corning, N. Y. Left to right, around table: H. Peterson, C. Clarkson, E. Witte, M. Buzan, Chairman E. H. Church, J. McLaughlin, M. Robertson, R. Robertson and R. Nagel.

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(Continued on page 26A)

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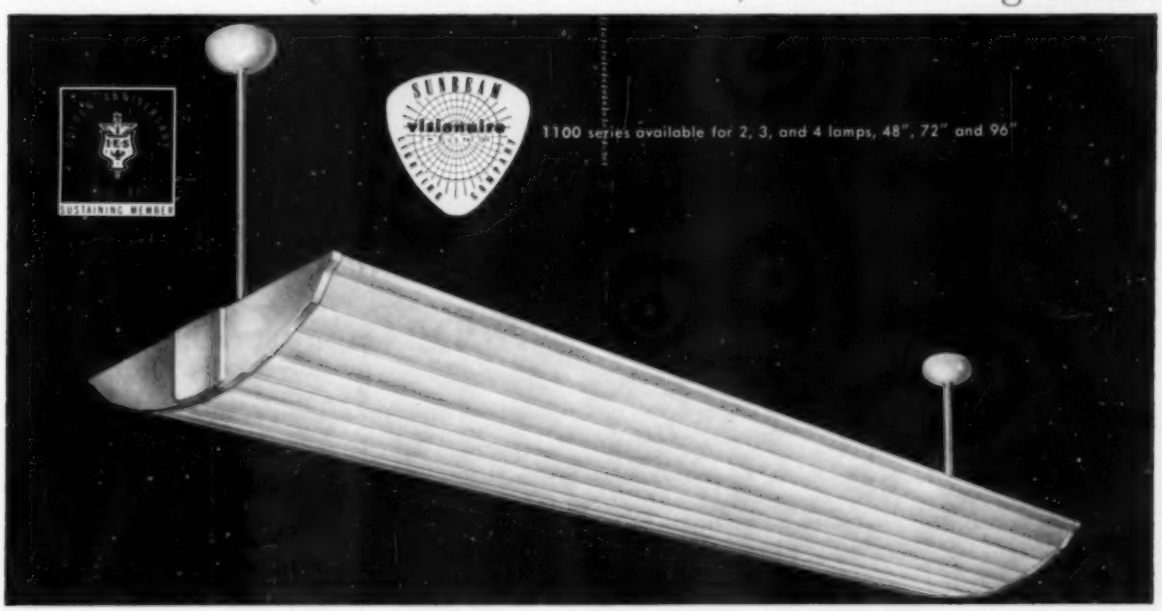

hinges into place without tools for quick installation. The **1100** series relamps from the top without removing any part of fixture. Units available for use with higher lumen lamps, typical of today's trend. All metal parts are Bonderite-treated for lifetime corrosion resistance. Write for Bulletin 747 today.

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(Continued on page 29A)

How HAPCO Poles cut maintenance on the New York Thruway...

When the New York Thruway planners specified HAPCO Aluminum alloy lighting standards for the Tappan Zee Bridge, they specified the end of pole painting maintenance. For this most concentrated over-the-water lighting installation in the world posed a major maintenance problem due to its exposure to great amounts of moisture.

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HUBBARD ALUMINUM PRODUCTS COMPANY
Division of Hubbard & Company, Pittsburgh 1, Pa.

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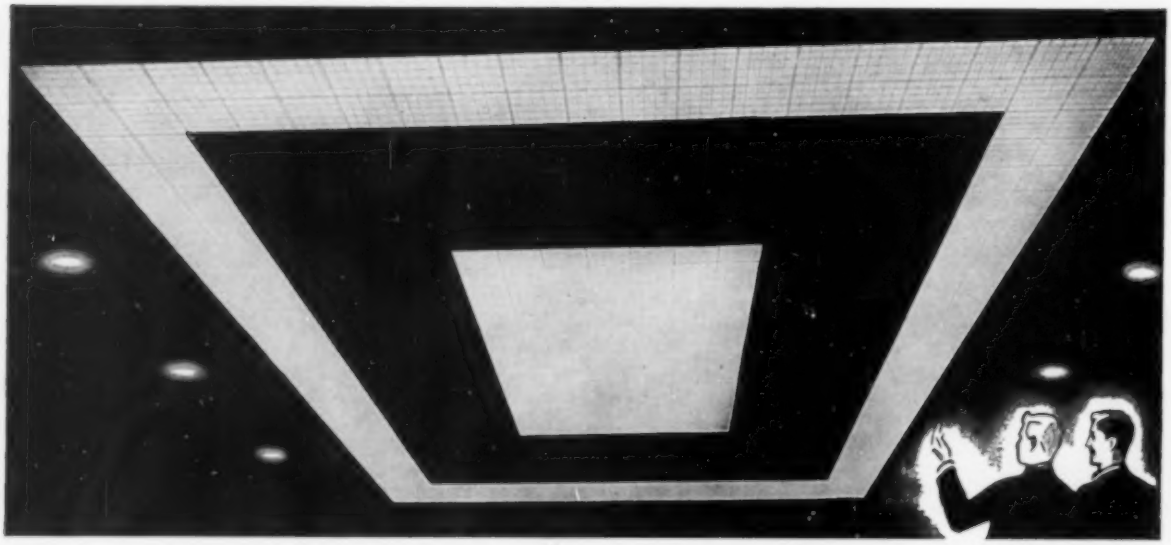
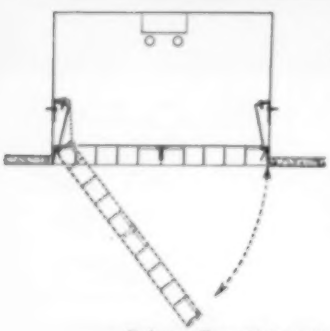
in every new building . . . or re-lighting job





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(*Continued from page 26A*)

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Gill Glass & Fixture Co.
Amber & Tioga Sts.
Philadelphia 34, Pa. — *C. A. Gill*

Gillinder Brothers, Inc.
Erie & Liberty Sts.
Port Jervis, N. Y. — *J. Fletcher Gillinder*

Great Northern Mfg. Corporation
4221 Harrison St.
Chicago, Ill. — *D. J. Epp*

Grimes Manufacturing Co.
515 No. Russell St., Urbana, Ohio — *L. B. Moore*

Guardian Light Company Inc.
500 North Blvd., Oak Park, Ill. — *W. S. Akely*

The Edwin F. Guth Co.
2615 Washington Ave.
St. Louis 3, Mo. — *Fred E. Guth*

H & H Fixture Co.
1313 Walton Ave.
St. Louis 13, Mo. — *D. A. Finazzo*

Hahn Electric Co., Inc.
Manchester & Barrett Sta. Road
P. O. Box 3848, Kirkwood 22, Mo. — *R. Hahn, Jr.*

Holophane Company, Inc.
342 Madison Ave
New York 17, N. Y. — *H. L. Logan*

Holophane Company, Limited
150 The Queensway
Toronto 14, Ont., Canada — *Frank T. Groome*

House-O-Lite Corporation
2430 S. Ashland Ave.
Chicago 8, Ill. — *Jack R. Stone*

Hubbard and Company
6501 Butler St., Pittsburgh 1, Pa. — *C. C. Warne, Jr.*

Hyland Electrical Supply Co.
623 W. Monroe St., Chicago, Ill. — *William Collyer*

Ideal Industries, Inc.
1000 Park Ave.
Sycamore, Ill. — *G. B. Koch*

Illuminating Engineering Co.
2347 E. Nine Mile Road
Hazel Park, Mich. — *Bert C. Pretzer*

Jefferson Electric Co.
Bellwood, Ill. — *W. C. Anderson*

Joleco Corporation
2513 Baldwin St.
St. Louis, Mo. — *George Ledbetter*

Jones Metal Products Co.
West Lafayette, Ohio — *H. Boyer*

Joslyn Mfg. & Supply Co.
3700 South Morgan St.
Chicago 9, Ill. — *J. H. Fahey*

The Kayline Company
2480 E. 22d St.
Cleveland 15, Ohio — *M. A. Eskins*

Keystone Electric Manufacturing Co.
2228-36 E. Tioga St.
Philadelphia 34, Pa. — *Leonard M. Siegel*

Kirchmer Bros. Mfg. Co.
2146 Newhouse Ave.
St. Louis 7, Mo. — *A. W. Kirchmer*

The Kirlin Company
3435 E. Jefferson Ave.
Detroit 7, Mich. — *Ivan Kirlin*

Light and Power Utilities Corp.
1035 Firestone Blvd.
Memphis 7, Tenn. — *Murray Reiter*

Light Control Co.
2533 East Olympic Blvd.
Los Angeles, 26, Calif. — *Stanley E. Lindahl*

Lighting Products, Inc.
2259 W. Park Ave.
Highland Park, Ill. — *Joseph A. Schneller*

Line Material Co., Division of McGraw Electric Co.
700 W. Michigan St.
Milwaukee 1, Wis. — *M. C. Harsh*

Litecontrol Corp.
16 Pleasant St.
Watertown 72, Mass. — *Lawrence E. Brown*

Litecraft Manufacturing Corp.
8 East 36th St., New York 16, N. Y. — *Ben Rosman*

Lithonia Lighting Products Co., Inc.
Lithonia, Ga. — *Robert J. Freeman*

Luminator, Inc.
120 N. Peoria St.
Chicago 7, Ill. — *Albert L. Arenberg*

Luminous Ceilings, Inc.
2500 West North Ave.
Chicago 47, Ill. — *Louis Rosenstein*

Luxor Lighting Products Inc.
Empire State Building
New York, N. Y. — *Sergei Markotan*

Magni Flood Inc.
38 North Second Ave.
Mt. Vernon, N. Y. — *Bert Greene*

Major Equipment Company Inc.
4603-19 Fullerton Ave.
Chicago, Ill. — *Ross O. Major*

R. A. Manning Co.
1810 North Ave.
Sheboygan, Wis. — *R. A. Manning*

Marlou Lights, Inc.
60 South Ave.
Fanwood, N. J. — *W. F. Calcagno*

Marvin Manufacturing Co.
648 Santa Fe
Los Angeles, Calif. — *Carl O. Anderson*

McPhilben Manufacturing Co., Inc.
1329 Willoughby Ave.
Brooklyn 37, N. Y. — *Edward L. Gluck*

Metalcraft Products Co., Inc.
Mascher & Lippincott Sts.
Philadelphia 33, Pa. — *Fred M. Pyle*

Midwest Chandelier Co.
15th & Gentry Sts.
No. Kansas City 16, Mo. — *Sidney Lefkovitz*

The Miller Co.
Meriden, Conn. — *G. W. Beals*

Mine Safety Appliances Co.
201 N. Braddock Ave.
Pittsburgh 8, Pa. — *R. E. Havener*

Mitchell Lighting
A Division of Compco Corp.
2251 West St. Paul Ave.
Chicago 47, Ill. — *George Kielty*

Mitchell Manufacturing Co., Ltd.
19 Waterman Ave.
Toronto 13, Ont. — *J. E. Landers*

Modern Light Company
7809 Maplewood Industrial Court
Maplewood 17, Mo. — *Edwin L. Ehret*

Modern Light & Equipment Co.
3812 S. Wabash Ave.
Chicago, Ill. — *M. L. Offenberg*

Morlite Equipment Co.
P. O. Box 106, Girard, Pa. — *Finley J. Gordon*

Multi Electric Mfg. Co.
4223-43 West Lake St.
Chicago, Ill. — *Leo J. McDonald*

Neo Ray Products Incorporated
315 East 22nd St.
New York 10, N. Y. — *Philip Young*

Nepo Mfg. Co.
4230 N. Sayre Ave.
Chicago 34, Ill. — *N. E. Passman*

Newman Schranz Lighting Co.
2700 Walnut
Denver, Colo. — *Charles Newman*

(*Continued on page 30A*)

Sustaining Members — Lighting Equipment Manufacturers

(*Continued from page 29A*)

Northern Light Co.
1657 No. Water St.
Milwaukee 2, Wis. *Fred Cramer*

The Novelty Lighting Corp.
2480 E. 22nd St.
Cleveland 15, Ohio *M. W. Terkel*

NuArt Lighting & Mfg. Co.
235 East 5th South St.
Salt Lake City, Utah *H. A. Schoepf*

Peerless Electric Limited
5585 Fullum, Montreal 36, Que. *L. A. Van Duzer*

The Perfeclite Company
1457 E. 40th St.
Cleveland, Ohio *Joseph L. Jaffe, Jr.*

Philadelphia Electrical & Mfg. Co.
1228-36 N. 31st St.
Philadelphia 21, Pa. *R. A. Manwaring*

Pittsburgh Reflector Co.
403-411 Oliver Bldg.
Pittsburgh 22, Pa. *H. C. Zinsmeister*

Powerlite Devices, Limited
1870 Davenport Rd.
Toronto 9, Ont. *M. B. Hastings*

Prescolite Manufacturing Corp.
2229 Fourth St.
Berkeley 10, Calif. *W. D. Runswick*

Pryne & Co., Inc.
P.O. Box 698, Pomona, Calif. *Rogert W. Holston*

Pyle National Company
1334 N. Kostner
Chicago 51, Ill. *A. G. Voelkner*

Quadrangle Mfg. Co.
32 So. Peoria St., Chicago 7, Ill. *J. D. Auckland*

Rambusch Decorating Co.
40 W. 13th St.
New York 19, N. Y. *Edward Rambusch*

Revere Electric Mfg. Co.
6009-17 Broadway
Chicago 40, Ill. *Murray J. Whitfield*

Ritter Co., Inc.
400 West Ave.
Rochester 3, N. Y. *Horace W. Alexander*

Rosemount Industries, Limited
2090 Moreau St.
Montreal, Que., Canada *Paul A. Ducasse*

Ruby Lighting Corp.
1212 South Olive St.
Los Angeles, Calif. *Milton Weiner*

Ruby-Philite Corp.
32-02 Queens Blvd.
Long Island City 1, N. Y. *Louis Phillips*

The Safety Car Heating & Lighting Co.
P.O. Box 70, Milford,Conn. *H. W. Jones*

Shalda Manufacturing Co., Inc.
156 W. Providence
Burbank, Calif. *William Shalda*

Silvray Lighting, Inc.
R.K.O. Bldg., Radio City
New York 20, N. Y. *J. M. Gilbert*

Smithcraft Lighting Division
A. L. Smith Iron Company
217 Everett Ave.
Chelsea 50, Mass. *Hugh M. Nazor*

Smoot-Holman Co.
321 No. Eucalyptus Ave.
Inglewood, Calif. *L. A. Hobbs*

Sola Electric Co.
4633 W. 16th St., Chicago 50, Ill. *L. C. Marschall*

Solar Light Mfg. Co.
400 N. Ashland Ave.
Chicago 22, Ill. *Bernard Laxerson*

Solux Corporation
58-17 28th Avenue, Woodside 77
Long Island, N. Y. *A. E. Spinetta*

Southern Lighting Mfg. Co.
501 Elwell St., Orlando, Fla. *Max K. Aulick*

The Spero Electric Corp.
20500 St. Clair Ave.
Cleveland 17, Ohio *O. Manny Spero*

Stanley Electric Mfg. Co.
3700 S. 80th St.
Philadelphia, Pa. *Bernard S. Heller*

Steber Manufacturing Co.
2700 Roosevelt Rd., Broadview
Maywood, Ill. *Robert J. Besal*

Sterling Reflector & Mfg. Co.
3249 West Grand Ave.
Chicago 51, Ill. *Anton Overhuber*

Stonco Electric Products Co.
333 Monroe Ave., Kenilworth, N. J. *H. W. Spence*

Sunbeam Lighting Co.
777 E. 14th Place
Los Angeles 11, Calif. *Herbert L. Krieger*

Sun-Lite Manufacturing Co.
2555 Bellevue Ave., Detroit 7, Mich. *Fred Binder*

Sun-Ray Fluorescent Co.
2025 South Michigan Ave.
Chicago, Ill. *Jerome Gimbel*

Supreme Lighting Company
600 Turner St.
Los Angeles 12, Calif. *J. Shapiro*

Thompson Electric Co.
1111 Power Ave.
Cleveland 14, Ohio *Robert K. Farrington*

Tri-Part Mfg. Company
934 Plum Street
Detroit 1, Mich. *Julius Reznik*

Unistrut Corp.
4118 Monroe Ave.
Wayne, Mich. *Hugo E. Rebentisch*

Unistrut Products Company
1013 W. Washington Blvd.
Chicago 7, Ill. *George W. Butler*

Voigt Company
1636-38 N. Carlisle St.
Philadelphia 21, Pa. *C. J. Frank*

The Wakefield Co.
Vermilion, Ohio *A. F. Wakefield*

Webb Electric Mfg. Co.
1701 S. W. Jefferson St.
Portland 1, Ore. *F. E. Webb*

Welsbach Engineering and Management Corp.
1500 Walnut St.
Philadelphia 2, Pa. *H. H. Adams*

Westinghouse Electric Corp.
1216 W. 58th St. (P.O. Box 5817)
Cleveland 2, Ohio *E. C. Huerkamp*

Wheeler Reflector Co.
275 Congress St.
Boston 10, Mass. *Harlan B. Fletcher*

R. & W. Wiley, Inc.
119 Dearborn St.
Buffalo 7, N. Y. *Robert C. Graves*

H. E. Williams Products Co.
108 S. Main St., Carthage, Mo. *F. B. Williams, Jr.*

Wilmot Castle Co.
1255 University Ave.
Rochester 7, N. Y. *E. H. Greppin*

J. A. Wilson Lighting & Display Ltd.
280 Lakeshore Rd.,Toronto, Ont. *J. A. Wilson*

The Wiremold Company
Hartford 10, Conn. *Robert H. Murphy*

Wright Light, Inc.
2924 Commerce St. (P.O. Box 4155)
Houston, Texas *Merrill C. Wright*

RESIDENTIAL LIGHTING EQUIPMENT

MANUFACTURERS

Colonial Premier Corp.
466 W. Superior St.
Chicago 10, Ill. *M. H. Dottenheim*

H. A. Framburg & Co.
5320-28 Carroll Ave.
Chicago 24, Ill. *Stanley A. Framburg*

Globe Lighting Products Co., Inc.
1710 Flushing Ave.
Brooklyn 6, N. Y. *Isidor Rosenblatt*

Jeryl Lighting Products, Inc.
42 W. Cermak Road
Chicago, Ill. *Chas. Meyerson*

Jewel Electric Products, Inc.
266 Glenwood Ave.
Bloomfield, N. J. *Joseph G. Wares*

Lightolier Co.
11 East 36th St.
New York 16, N. Y. *W. F. Blitzer*

Moe Light, Inc.
410 So. Third St.
Louisville 2, Ky. *Frank Marriett*

Mutual Sunset Lamp Mfg. Co., Inc.
540 Empire State Bldg.
New York 1, N. Y. *Morris Thau*

Sandel Manufacturing Co.
3618 So. Loomis Place, Chicago 9, Ill. *A. L. Sandel*

John C. Virden Co.
6009-6103 Longfellow Ave.
Cleveland 3, Ohio *John C. Virden, Jr.*

John C. Virden, Ltd.
19 Curity Ave., Toronto, Ont. *P. G. Kirkpatrick*

(*Continued on page 32A*)

new dimension...

in fixture value with THE *new* SMITHCRAFT FINISH

Smithcraft now adds a new dimension in fixture perfection. The new Smithcraft painting process consists of the finest and most modern Bonderite and Baked Enamel Finish combination in use in the lighting industry today.

In addition to its superior appearance, the new Smithcraft finish has these outstanding qualities:

Adheres firmly to metal — Stays white indefinitely, without yellowing — Provides positive resistance to chemicals and heat — Resists abrasion because of optimum hardness — Reflects a maximum percentage of light

Because the new Smithcraft finish possesses all these attributes to a greater degree than ordinary finishes, it produces many important new benefits for owners and users of lighting . . . better appearance, better lighting qualities, easier maintenance and longer, trouble-free life.

All the units in the complete and diversified line of Smithcraft commercial and industrial fixtures are now finished with this new process. Typical is the Sheraton (shown above) . . . a trim, modern unit, only 3¼" deep; the Sheraton is ideal for low-ceiling applications. It is available for two and four-lamps in 4-ft. and 8-ft. lengths. Plan to use the Sheraton in your next school, store or office design.

Ask us to send you the current Smithcraft catalog . . . it is a compilation of the newest and most functional fluorescent fixtures in use today.

Smithcraft
LIGHTING
CHELSEA 50, MASSACHUSETTS

America's finest fluorescent lighting

WELCOME, I. E. S. MEMBERS!
While you're in Boston, plan to visit us and tour our newly expanded plant facilities — just 10 minutes from downtown Boston. We'll be glad to see you!

 (Continued from page 30A)

LAMP MANUFACTURERS

Canadian General Electric Co., Ltd.
Lamp Division
165 Dufferin St.,Toronto, Ont. *E. H. Lindsay*

Champion Lamp Works Div. of
Consolidated Electric Lamp Co.
600 Broad St., Lynn, Mass. *Ellery H. Raddin*

Duro Test Corp.
2321 Hudson Blvd.
North Bergen, N. J. *James L. Cox*

General Electric Co., Lamp Dept.
Nela Park
Cleveland 12, Ohio *Willard C. Brown*

Sylvania Electric Products Inc.
1740 Broadway
New York 19, N. Y. *D. P. Caverly*

Sylvania Electric (Canada) Ltd.
Suite 522, University Tower Bldg.
Montreal, Que., Canada *F. W. Fulle*

Voltarc Tubes, Inc.
44 Cross St., Norwalk, Conn. *Wallace G. Hill*

Westinghouse Lamp Div.
Bloomfield, N. J. *Marshall N. Waterman*

DISTRIBUTORS AND CONTRACTORS

American Electric Supply Co.
175 Ann St., Hartford, Conn. *L. A. Senofonte*

Black & McDonald Limited
200 King Street W.
Toronto, Ont., Canada *W. J. McDonald*

California Electric Supply Co.
12th and Folsom Sts.
San Francisco, Calif. *Sol Cohn*

Canadian Westinghouse Supply Co. Ltd.
195 Fleet St. E.
Toronto, Ont., Canada *S. W. McKnight*

Capitol Light & Supply Co.
6-8 Huntley Place
Hartford, Conn. *Arnold S. Cartin*

Carroll Sales Co.
19554 James Couzens Highway
Detroit 35, Mich. *T. G. Carroll*

Chicago Electrical Supply Co.
420 N. Ashland Ave.
Chicago 22, Ill. *Charles Lechner*

Commercial Light Co.
841 W. Washington Blvd.
Chicago, Ill. *Michael R. Fine*

Efengee Electrical Supply Co.
949 W. Chicago Ave., Chicago 22, Ill. *Lee Mirus*

Electrical Wholesalers, Inc.
229 Whitehall St., S. W.
Atlanta, Ga. *John R. Thornton*

Electric Supply Corporation
701 W. Jackson Blvd.
Chicago 6, Ill. *Peter V. Polton*

Englewood Electrical Supply Co.
5801-03 So. Halsted St.,Chicago, Ill. *Ray O'Leary*

Enterprise Electric Co.
6507 Euclid Ave., Cleveland, Ohio *William S. Fell*

Fecht Electric, Inc.
5736 N. Western Ave.
Chicago 45, Ill. *William F. J. Fecht*

W. Freeman & Son Ltd.
275 Woodland Drive
Vancouver, B. C., Canada *A. Freeman*

General Electric Supply Company
A Division of General Electric Distributing Corp.
1260 Boston Ave.
Bridgeport 9, Conn. *W. W. Booth*

Gould Electric Co.
4318 N. Western Ave.
Chicago 18, Ill. *E. A. Gould, Jr.*

Graybar Electric Co., Inc.
420 Lexington Ave.
New York 17, N. Y. *Raymond C. Kinney*

Hawkins Electric Co.
1447 Washington Blvd.
Chicago 7, Ill. *R. R. Hill*

Hultgren Electric Corp.
5242 N. Damen Ave.
Chicago, Ill. *W. Hultgren, Jr.*

Jarvis Electric Supply Co.
784 South Crocker St.
Los Angeles 21, Calif. *David Bass*

Kelso-Burnett Electric Co.
223 W. Jackson Blvd.
Chicago 6, Ill. *Sigmund A. Hollinger*

Kil Bar Electric Co.
2261 Clybourn Ave.
Chicago 14, Ill. *H. J. Kilburg, Jr.*

Kirby Risk Supply Co., Inc.
302 Ferry St., Lafayette, Ind. *Glenn C. Stafford*

Lawrence Electric Co.
3511 N. Cicero, Chicago 41, Ill. *Frank Heise*

Main Electric Company
741 Milwaukee Ave.
Chicago, Ill. *William Kamin*

Malloy-Robinson Co.
1701 S. W. Jefferson St.
Portland,Ore. *Geo. Robinson*

La Cie Martineau Electrique Ltee.
24 rue du Roi, Quebec, Que. *Henri Martineau*

Meade Electric Company, Inc.
5401-15 W. Harrison St.
Chicago 44, Ill. *Henry E. Burkhardt*

Metropolitan Electrical Supply Co.
20 N. Jefferson St., Chicago 6, Ill. *Fred Pedrigi*

Miller Electric Co. of Florida
575 Dora St.
Jacksonville, Fla. *James Dandelake*

Monroe Electric Co.
157 W. Ontario St., Chicago 10, Ill. *Albert Kahn*

Noland Co.
27th St. & Virginia Ave.
Newport News, Va. *C. P. Andrew*

Northern Electric Co., Ltd.
1600 Notre Dame St., West
Montreal, Que., Canada. *K. M. Bissell*

Pierce Electric Co.
367 W. Adams St., Chicago 6, Ill. *John H. Pierce*

Portland Electric & Plumbing
905 S. W. 16th Avenue
Portland 5, Ore. *Ned Higgins*

G. A. Rafel & Co.
2112 W. Lawrence
Chicago 25, Ill. *George A. Rafel*

Revere Electric Supply Co.
2501 W. Washington Blvd.
Chicago 12, Ill. *Arthur Peterson*

Rumsey Electric Co.
1007 Arch St., Philadelphia 7, Pa. *T. W. Lauer*

Jas. E. Rust Electric Co., Inc.
1511 W. Jackson Blvd.
Chicago 7, Ill. *Earl C. Heller*

Service Electric Co.
8345 South Ashland, Chicago, Ill. *Harold Zwitt*

The Starbuck Sprague Co.
39 Spring St.
Waterbury, Conn. *E. A. Madison*

Sticklor Electric Supply Co.
346 Ann St.
Hartford 3, Conn. *Marshall Sticklor*

Stubbs Electric Co.
33 N. W. Park Avenue
Portland 9, Ore. *W. T. R. Saari*

Super Electric Construction Co.
4300 W. Chicago Ave.
Chicago 51, Ill. *P. M. Pavesich*

Frank C. Teal Co.
3222-24 E. Jefferson
Detroit 7, Mich. *Harold C. Smith*

Terreau-Racine Ltee.
196-228 St. Paul St.
Quebec, Que., Canada *Georges Langlais*

B. M. Tower Co., Inc.
Dewey St., Bridgeport, Conn. *Harvey N. Tower*

Warren Electric Co.
P. O. Box 2594, Houston, Texas *J. R. Thompson*

Westinghouse Electric Supply Co.
113 North May St., Chicago 7, Ill. *B. H. Boatner*

Wholesale Electrical Supply Co.
7333 Cottage Grove Ave.
Chicago 19, Ill. *Raymond D. Arenberg*

Wiedenbach-Brown Co., Inc.
111 Eighth Ave.
New York 11, N. Y. *W. C. Stockberger*

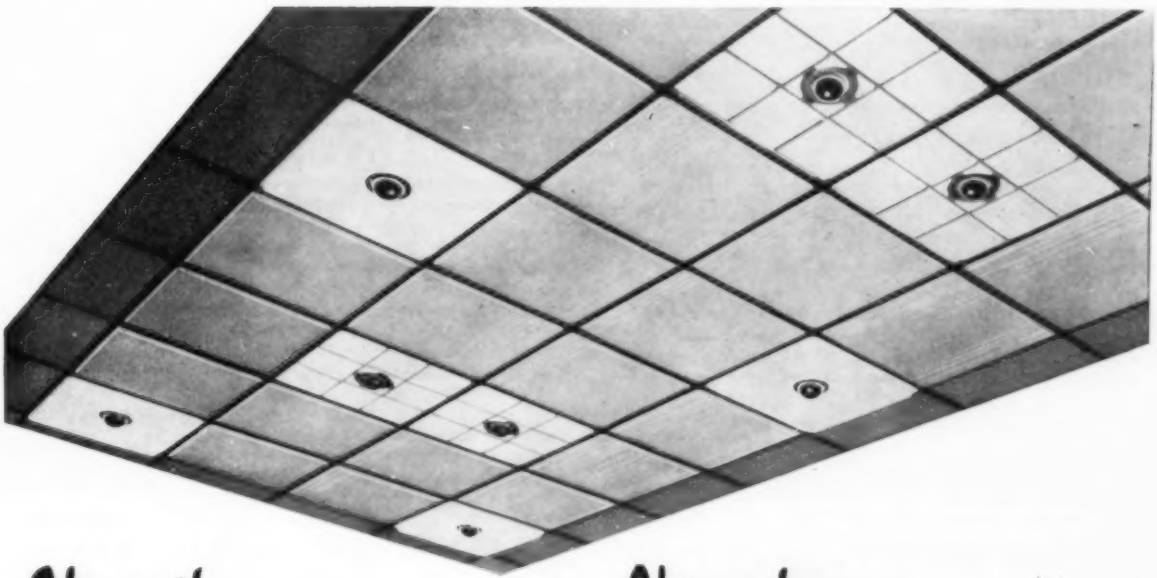
Wigdahl Electric Company
4246-48 Milwaukee Ave.
Chicago 41, Ill. *T. J. Wigdahl*

Zenith Electric Supply Limited
177 King St.
Toronto, Ont., Canada *B. R. Steen*

(Continued on page 34A)

"Wall-to-Wall" OR "By-the-Yard"

THE NEW SILVRAY APPROACH TO AREA ILLUMINATION



Skyceil "WALL-TO-WALL"

The perfect approach to complete area illumination—tailored to meet the architectural irregularities of any ceiling. It is, however, designed so that all those irregularities disappear into a smooth, flowing ceiling of soft, glare-free light. Whether the area is a small office, a lobby or a large department store—SKYCEIL will solve the problem. Available in two types . . .

SKYCEIL 1

The all silvered bowl incandescent system utilizing special Skylike 24" square louvered units. Reflector is designed to provide upward light which is deflected by the ceiling to softly illuminate the adjacent plastic panels.

SKYCEIL 2

A system in which the standard Skyceil unit (without upward lighting component) and supplementary, unseen fluorescent lighting above the Skyceil grid are combined to provide overall lighting of desired footcandle level.

Skyceil is available with metal eggcrate louver, 1 or 8 piece plastic diffusers.

SKYLIKE LIGHTING, INC.
A SILVRAY ASSOCIATED COMPANY
RKO Bldg., New York • Bound Brook, New Jersey

Skysector "BY-THE-YARD"

Provides the same effect as SKYCEIL but at a sizeable saving in installation. SKYSECTOR is designed to utilize the largest area of a ceiling without being wall-to-wall. An ingenious method of suspension makes this possible and provides a soft glowing panel of diffused light around its perimeter in place of the costly-to-install panel border. For those who desire the effect of complete ceiling illumination that is lower in price, SKYSECTOR, the "buy-it-by-the-yard" concept is the perfect answer.

Skysector system is available with either Skyceil 1 or Skyceil 2 units thereby providing the same lighting quality and efficiency. For complete details fill in and mail coupon below.

SKYLIKE LIGHTING, INC.
100 Main St. W., Bound Brook, New Jersey

Dear Sirs:

I would like additional information on the Skylike Systems of Area Illumination and have indicated below the one(s) in which I am interested.

SKYCEIL . . . . . ☐ SKYSECTOR . . . . . ☐

NAME _____

COMPANY NAME _____

ADDRESS _____

_____ _____

 (Continued from page 32A)

RELATED MANUFACTURERS AND MISCELLANEOUS

Aluminum Co. of America
New Kensington, Pa. — *C. J. Hinton*

American Concrete Corp.
5092 N. Kimberly Ave.
Chicago 30, Ill. — *J. W. Lewis*

American Sterilizer Co.
2426 West 23rd St.
Erie, Pa. — *Ernest L. Thompson*

Barrett Division
Allied Chemical & Dye Corp.
S. Ridgeway Ave.
Glenolden, Pa. — *Dr. M. H. Bigelow*

Blue Ridge Glass Corp.
Kingsport, Tenn. — *James Herbert*

Canadian National Exhibition Association
Exhibition Park, Toronto, Ont. — *H. E. McCallum*

Canning, Pekara, Inc.
2144 N. Wood St.
Chicago 14, Ill. — *Claude E. Canning*

Continental Electrical Construction Co.
3540 Southport Ave., Chicago 13, Ill. — *Leo W. Witz*

Corning Glass Works
Corning, N. Y. — *George W. Douglas*

Coyne Electrical School, Inc.
500 So. Paulina St., Chicago 7, Ill. — *John Hanan*

Detroit Electrical Contractors Association
740 Book Building
Detroit 26, Mich. — *Carl J. Schoeninger*

Dow Chemical Co.
Midland, Mich. — *W. C. Goggin*

E. I. duPont de Nemours & Co., Inc.
(Fabrics & Finishes Div.)
Wilmington 98, Del. — *S. W. Quisenberry*

E. I. duPont de Nemours & Co., Inc.
Polychemicals Dept.
Development and Service Section
Wilmington 98, Del. — *Henry Peterson*

Eastman Kodak Co.
343 State St., Rochester, N. Y. — *H. R. Patterson*

Ebasco Services, Inc.
2 Rector St., New York 6, N. Y. — *W. L. Byrne*

Electrical Information Publications, Inc.
20 N. Carroll St.
Madison, Wis. — *D. W. Grosshandler*

Electrical Products Corporation
1100 North Main St.
Los Angeles 12, Calif. — *L. A. Rice*

Electrical Testing Laboratories, Inc.
79th St. & East End Ave.
New York 21, N. Y. — *W. F. Little*

Fenestra Inc.
2250 E. Grand Blvd.
Detroit 11, Mich. — *E. W. Conover*

The France Mfg. Co.
10325 Berea Road
Cleveland 2, Ohio — *E. L. Walter*

Franklin Design Service
Division of Safeway Stores, Inc.
P.O. Box 660
Oakland 4, Calif. — *Andrew W. Anderson*

General Electric Co.
Accessory Equipment Dept.
1285 Boston Ave., Bldg. 32-EE
Bridgeport 2, Conn. — *William B. Dexter*

General Fireproofing Co.
Dennick Ave., Youngstown, Ohio — *J. A. Saunders*

The Hankins Container Co.
14801 Emery Ave.
Cleveland 11, Ohio — *Ray T. White*

Hexcel Products Inc.
951 61st St., Oakland 8, Calif. — *Robert C. Spott*

Hub Electric Company
2219 W. Grand Ave.
Chicago 12, Ill. — *I. M. Fixman*

Jeanette Shade & Novelty Co.
N. Fourth St.
Jeanette, Pa. — *Donald H. Crock*

Kopp Glass, Inc.
Swissvale, Pa. — *F. C. Ashe*

K-S-H Plastics, Inc.
Highway 50
High Ridge, Mo. — *R. S. Hawes III*

The Leeds & Northrup Co.
4901 Stenton Ave.
Philadelphia 44, Pa. — *Dr. R. C. Machler*

Leviton Mfg. Co.
236 Greenpoint Ave.
Brooklyn 22, N. Y. — *Jack Amsterdam*

Lighting Services Co.
515 Meriden Road
Waterbury, Conn. — *Richard L. Platt*

Macbeth Corp.
P.O. Box 950, Newburgh, N. Y. — *Norman Macbeth*

McGill Manufacturing Co., Inc.
909 Lafayette St.
Valparaiso, Ind. — *W. E. Brownell*

Mississippi Glass Co.
518 Angelica St.
St. Louis 7, Mo. — *C. J. Youngblood*

Monsanto Chemical Co.
Plastics Division
Springfield 2, Mass. — *Eli A. Haddad*

Charles C. Munroe, Jr.
25741 Kennedy Drive
Dearborn, Mich. — *Charles C. Munroe, Jr.*

National Chemical & Manufacturing Co.
Luminall Paint Div.
3617 So. May St.
Chicago 9, Ill. — *John Marshall Zn*

Pfaff & Kendall
84 Foundry St.
Newark, N. J. — *M. J. Hamilton*

Phoenix Glass Co.
Monaca, Pa. — *D. G. Cameron*

Pittsburgh Corning Corp.
1 Gateway Center
Pittsburgh 22, Pa. — *J. R. Nicholson*

Pittsburgh Plate Glass Co.
Grant Bldg., Pittsburgh 19, Pa. — *R. B. Tucker*

Plax Corp.
P.O. Box 1019, Hartford, Conn. — *C. N. Sprankle*

Progressive Products Co., Inc.
6615 Milwaukee Ave.
Chicago 31, Ill. — *E. George Goddard*

Prolon Plastic Division
Prophylactic Brush Co.
Florence, Mass. — *John H. Moore*

Rohm and Haas Co.
222 W. Washington Sq.
Philadelphia 5, Pa. — *H. A. Williams*

The Sherwin-Williams Co.
101 Prospect Ave., N.W.
Cleveland 1, Ohio — *J. A. Meacham*

Simpson & McGregor
1690 West Broadway
Vancouver, B. C. — *A. E. Simpson*

Standard Mfg. Corp.
1100 S. Central Park Ave.
Chicago, Ill. — *Elliott Tarson*

Starring & Co., Inc.
1600 Seaview Ave.
Bridgeport, Conn. — *Carl E. Paul, Jr.*

Steel Window Institute
Cheltenham, Pa. — *George Hingston*

The Superior Electric Co.
83 Laurel St.
Bristol, Conn. — *William P. Carpenter*

Underwriters' Laboratories, Inc.
207 E. Ohio St., Chicago 11, Ill. — *Fred Neumer*

Union Metal Mfg. Co.
Canton 5, Ohio — *W. A. Porterfield*

Universal Mfg. Corporation
29-51 E. 6th St., Paterson, N. J. — *Imrich Miller*

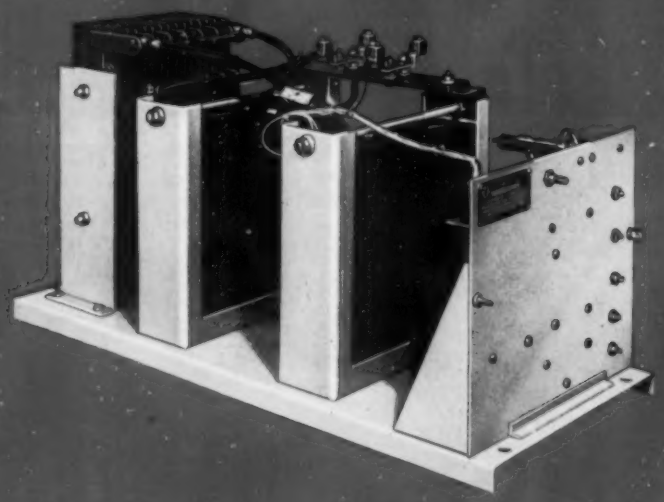
Wasco Products Inc.
Bay State Rd.
Cambridge, Mass. — *Selig M. Friedberg*

White Way Electric Sign & Maintenance Co.
1317 Clybourn Ave.
Chicago 10, Ill. — *Martin Davis*

I.E.S. Emblem — Available during Anniversary Year for Use by Sustaining Members

During this 50th Anniversary year, Sustaining Members of the Society have been granted the privilege of using the I.E.S. Emblem in their advertising. This privilege, which has never before been extended, will be in effect for Sustaining Members only, and only for the year 1956.

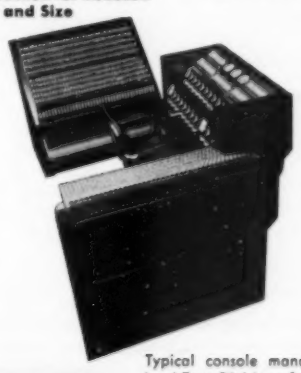
NBC again installs



VICKERS* MAGNETIC AMPLIFIER TYPE DIMMERS!

WHY VICKERS DIMMERS PROVIDE BETTER LIGHTING CONTROL

- New Wide 30-1 Load Range
- No Tubes or Moving Parts
- Inherently Stable
- Redesigned closed-core Power Section for Reduced Weight and Size
- Greater Efficiency
- Fast Response
- Remote Control
- Easy Installation
- Dependable Performance



Typical console manufactured by Lumi-Tron Division of Metropolitan Electric Manufacturing Co. for control of Vickers Dimmers in NBC-TV Color Studios.

*TRADEMARK

230 Dimmers Used in Three NEW Color Television Studios

Following two years of outstanding performance in NBC's elaborate color TV studio in Brooklyn, N. Y., Vickers Magnetic Amplifier Dimmers have been chosen by NBC and Metropolitan Electric Manufacturing Co. for three more of the network's facilities now under construction—at Burbank, Calif.; in the Ziegfeld Theater, New York City, and in a second studio in Brooklyn.

A total of 230 dimmers are included in the new installations, including 200 of 10 KW capacity, and 30 of 5 KW capacity.

Write for New Lighting Control Bulletin

VICKERS ELECTRIC DIVISION

VICKERS INCORPORATED a unit of Sperry Rand Corporation

1863 LOCUST STREET • SAINT LOUIS 3, MISSOURI

NEW EQUIPMENT DATA
AVAILABLE WITH COUPON

New manufacturers' catalogs and bulletins listed below are available free to readers of ILLUMINATING ENGINEERING by mailing the coupon. Circle the numbers of those items which you want, drop in envelope or fasten securely to back of 2-cent postcard addressed to Publications Office.

1 Form No. AEL-655 is 4-page folder giving complete descriptions, suggested uses, and installation recommendations for five BIG BEAM automatic emergency lights. U-C Lite Mfg. Co., Chicago, Ill.

2 Folder covers new line of fluorescent units for corridors, pedestrian tunnels, and similar long narrow traffic areas, giving installation data and engineering information. In various styles, units are called CORRALUME, CORRALINE and CORRALOUVER, and catalog sheets on each are also available. Day-Brite Lighting Inc., St. Louis, Mo.

3 Four-page folder shows FAST-LOK rigid-bar hangers which are adjustable between beams from 10 to 24 inches on centers and complete with snap-on stud or button to fit all types of switch and outlet boxes. Fast-Lok Mfg. Co., Bridgeport, Conn.

4 Catalog No. 445 covers 4x4 and 6x6 WIREWA metal raceways, which come in standard sized sections for housing electric wires and cables, shows special features of raceway, and suggests various applications where approved. National Electric Products Corp., Pittsburgh, Pa.

5 24-page, two-color catalog shows wide variety of luminous and louvered ceilings with and without acoustical baffles and available in several different patterns and styles. Ordering and installation details are included. Columbia Electric & Mfg. Co., Spokane, Wash.

6 12-page catalog GEC 983H contains wiring diagrams for fluorescent lamp ballasting circuits, cross-section dimensions, list prices, and electrical specifications for G.E. ballasts, including ballasts for general line fluorescents, plastic signs and outdoor applications, etc. General Electric Co., Schenectady, N. Y.

7 Catalog 545 contains complete line of incandescent, recessed mounted and hinged 12" LENSLITE for individual, continuous or pattern mounting. Catalog shows various special features and illumination data as well as installation information and specifications. Neo-Ray Products Inc., New York, N. Y.

8 Catalog page describes new mercury vapor street and highway luminaire, shows construction and installation details and special maintenance features. Accompanying report shows candlepower distribution and lamp data. Philadelphia Electrical & Mfg. Co., Philadelphia, Pa.

9 Bulletin describes features and uses of CHAIN-MATE lead wire, offered in several metallic colors and approved for use with decorative fixture chain hangers, both externally and inside chain links and tubes. Radix Wire Co., Cleveland, O.

10 GED-3001 is 28-page booklet dealing exclusively with lighting of turnpikes and expressways; lists recommendations for hazardous areas and devotes special attention to toll plazas, interchanges, bridges, etc., including application diagrams. General Electric Co., Schenectady, N. Y.

11 6-page folder describes PIOLITE vinyl plastic pans and corrugated luminous ceilings, shows shapes, and gives details of illumination qualities. Folder also describes company's washer for corrugated plastics used in luminous ceilings. Pioneer Plastics Corp., Peabody, Mass.

12 Complete catalog shows entire line of fluorescent commercial and industrial fixtures; mercury vapor outdoor luminaires; and postlights for outdoor installation. Great Northern Mfg. Co., Chicago, Ill.

13 16-page Catalog 87 contains detailed information on tapered steel and aluminum MONOTUBE floodlighting poles for outdoor use in sports, industrial and commercial areas. Diagrams show installation and mounting details; completely illustrated. Union Metal Mfg. Co., Canton, O.

14 Data sheet 56-A describes company's hinged, close-up ceiling pan luminaires and weatherproof wall and ceiling lights; gives illumination data as well as specification details. The Perfeclite Co., Cleveland, O.

15 New 12-page booklet covers gymnasium lighting; discusses problems of this application, and suggests various ways to achieve uniform illumination with minimum of direct glare. Includes studies with charts, diagrams, photographs and tables. Pittsburgh Reflector Co., Pittsburgh, Pa.

16 Complete 18-page catalog shows line of incandescent and fluorescent recessed fixtures, under-cabinet and exit lights, as well as services for custom manufacture; shows distribution curves, specifications and other data with ordering guide. Alkco Mfr. Co., Chicago, Ill.

17 Two-color, 4-page folder describes LIGHTMASTER adjustable, portable units for supplementary lighting below eye level. Shows various types and mountings. The O. C. White Co., Worcester, Mass.

18 New manual on lighting of hardware stores is written from retailer's point of view and contains pointers on proper lighting in relationship to store location, types of merchandise handled, maintenance, and store flexibility; shows typical layouts, hints on lighting system selection and other data. Sylvania Electric Products Inc., New York, N. Y.

19 Four-page, two-color folder covers THINLITE line of fluorescent troffer luminaires for individual or continuous row mounting which require only 2⅞" above ceiling line for space-saving installation and with a variety of diffusers.

(Continued on page 67A)

Offer good for two months

Circle numbers wanted. Enter name and address. Clip out and mail.

PUBLICATIONS OFFICE 9-58
ILLUMINATING ENGINEERING SOCIETY
1860 Broadway
New York 23, New York

Send me items circled below:

1	2	3	4	5	6	7	8	9	10	11	12
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Name .....

Company .....

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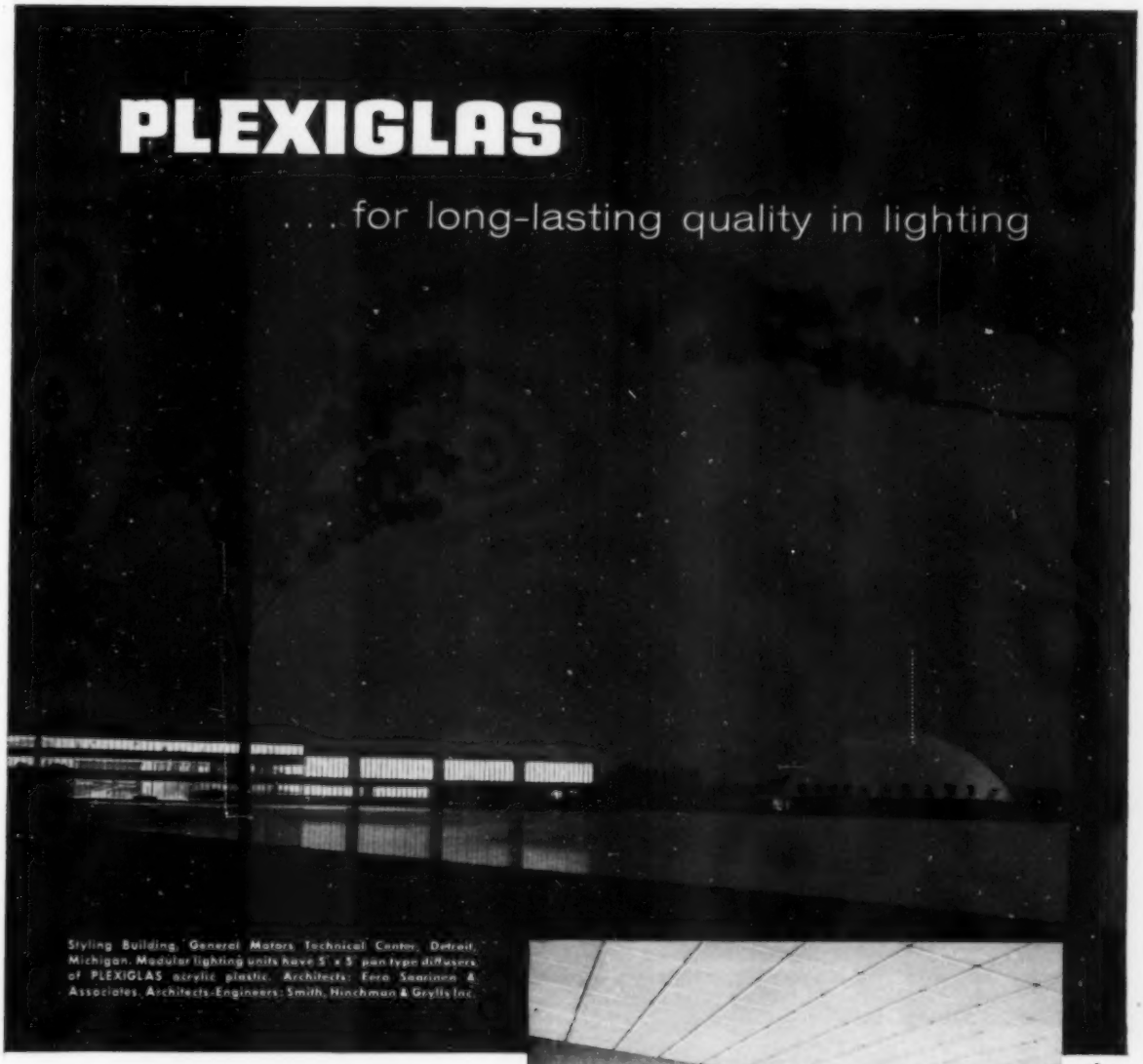
City ..... Zone ..... State .....

PLEXIGLAS

. . . for long-lasting quality in lighting



Styling Building, General Motors Technical Center, Detroit, Michigan. Modular lighting units have 5' x 5' pan type diffusers of PLEXIGLAS acrylic plastic. Architects: Eero Saarinen & Associates. Architects-Engineers: Smith, Hinchman & Grylls Inc.

When lighting systems are based on diffusion through PLEXIGLAS® they have the efficiency, permanence and beauty that add up to illumination of the highest quality. This acrylic plastic provides superior transmission and diffusion of light. It is rigid, strong and durable, with exceptional freedom from discoloration on long exposure to fluorescent lamps. At the General Motors Technical Center, nearly seven acres of PLEXIGLAS attest its advantages as a lighting material. Write for our booklet, "Architectural Lighting with PLEXIGLAS." It shows many of the diffuser shapes and designs that are available from lighting equipment manufacturers.

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.*

You can stop this costly confusion!

Here's a maintenance man with a serious problem. His job—replace a defective lamp in a lighting fixture equipped with a series slimline ballast. One lamp has burned out causing the other to burn dimly or go out completely. But which is the defective lamp—shall he guess or test. Either way, your customers lose time and money from his confusion.

You can stop this unnecessary waste by specifying Westinghouse slimline *lead-lag* ballast—when one lamp burns out the other lamp is not affected. Maintenance men know at a glance which lamp to replace. They can perform their jobs quickly and efficiently without throwing out good lamps.

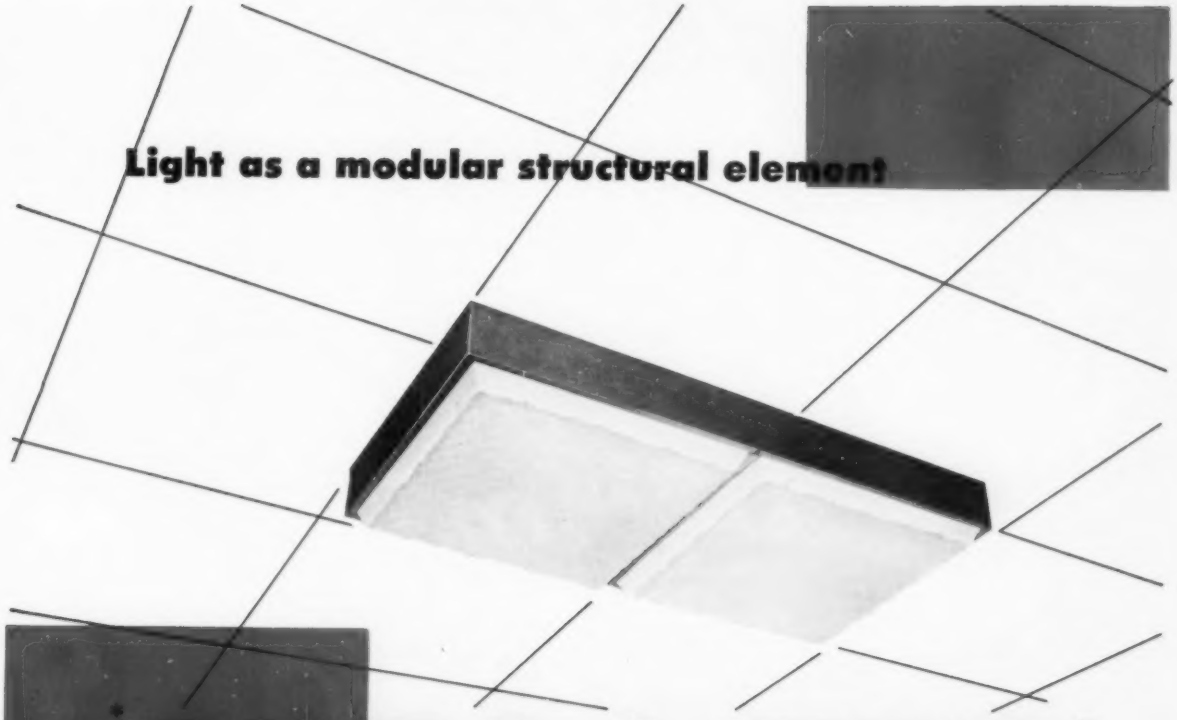
And you get an extra plus with Westinghouse slimline *lead-lag* ballasts.

The exclusive UI core design means cooler, quieter, and more efficient operation. For complete details about this unique ballast, see your Westinghouse representative. Or write Westinghouse Electric Corporation, Lighting Division, Edgewater Park, Cleveland, Ohio. J-04400

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***

Light as a modular structural element



AREA/LITER®

The trend in good lighting is toward low brightness luminous areas which are free from direct glare and provide wide distribution and freedom from the monotony of uniformly bright ceilings.

The AREA/LITER Modular Fluorescent Fixture is a totally enclosed surface unit specifically designed for application to this new principle of illumination. AREA/LITER provides the architect with an unlimited range of possibilities. Patterns can be combined on the same ceilings to supply desired levels of illumination for any particular area. The die-formed plastic diffusing panel has a simple, pleasing texture.

With AREA/LITER Surface Mounted Fixtures, a luminous area can be developed without the costly 1½ to 2 feet of extra ceiling height demanded by luminous ceilings.

*Patent pending

Pleasing light and distinction are features of AREA/LITER installations

superior fixtures for modern lighting

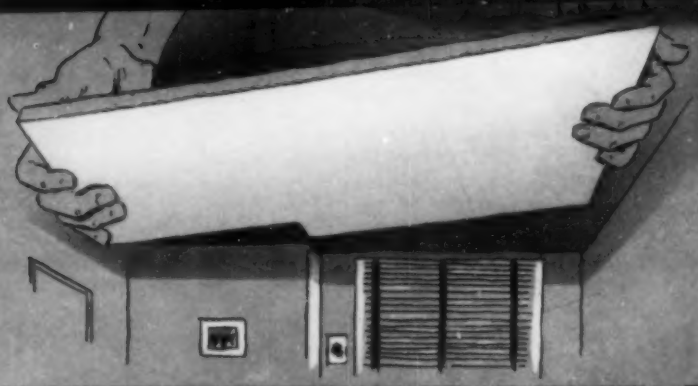
fluorescent fixtures of california

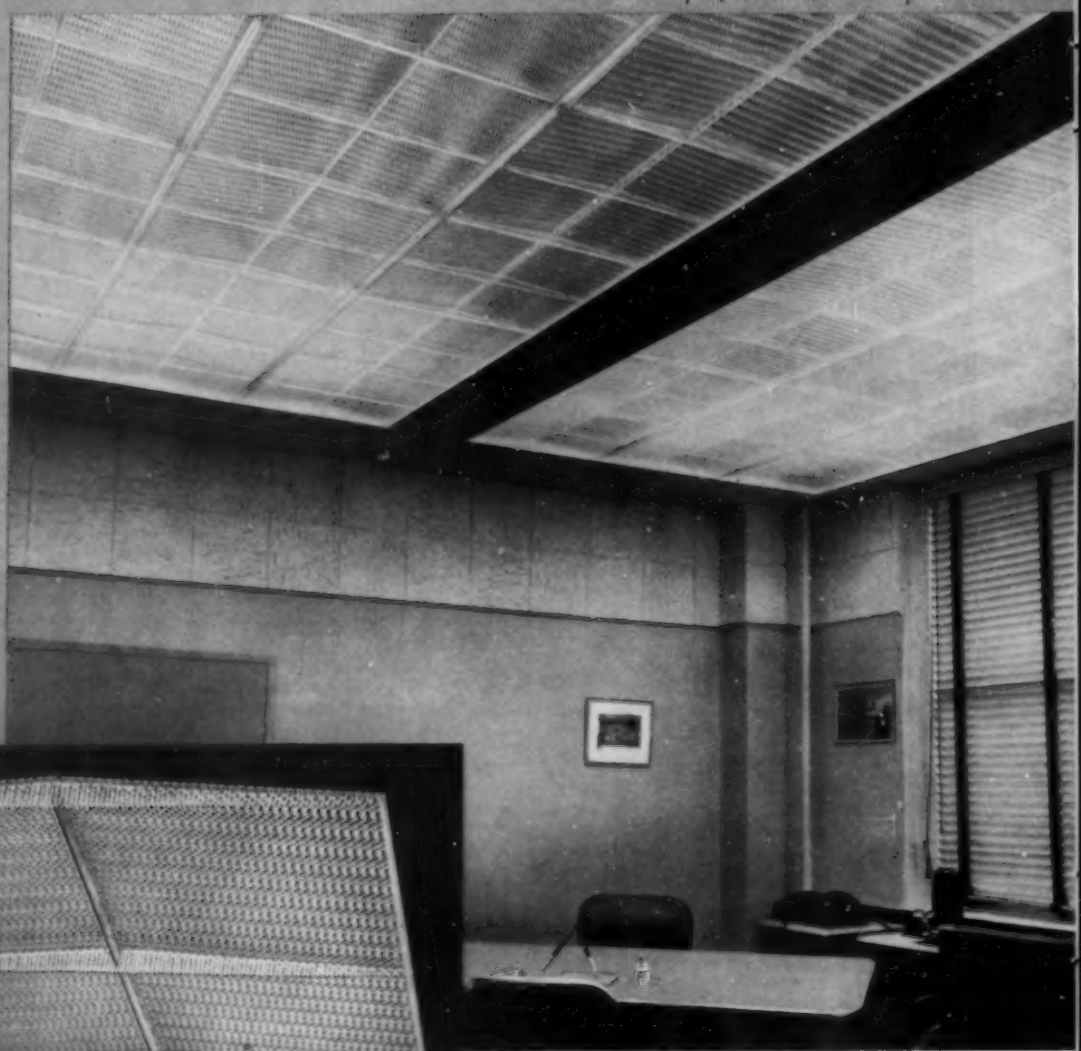
SOUTH SAN FRANCISCO: 352 SHAW ROAD
LOS ANGELES: 239 WEST 31ST STREET
PORTLAND, ORE.: 1318 S.W. FIRST AVENUE

All-Brite
LIGHT OF THE WEST

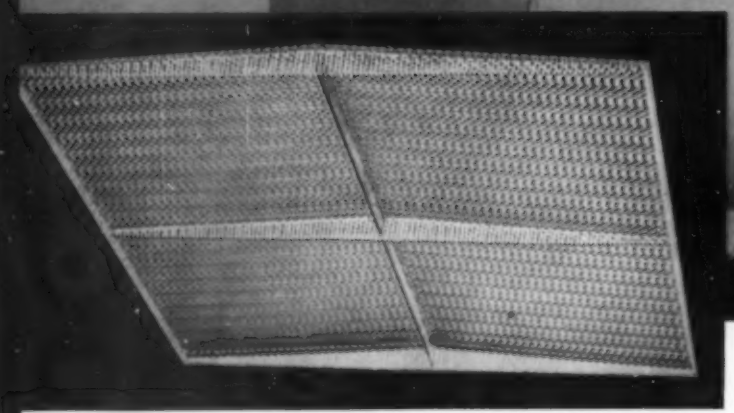
Holophane Engineers lifted the top off this room

and inserted the "sky" in the ceiling...





No. 6024
PRISMALUME*
CONTROLENS*
2-Foot Sq. (Approx.)



Whether for 2-foot-wide troffers of any length . . . or for large panels as shown above . . . the new HOLOPHANE No. 6024 PRISMALUME* is another tremendous step forward! . . . It produces maximum quantity of controlled light which provides complete visual comfort . . . Recommended for better fluorescent illumination of offices, showrooms, laboratories, stores, schools,—almost every form of modern installation...Write for detailed engineering data on this remarkable new Holophane development.

For Better Lighting Holophane *... Be Specific*

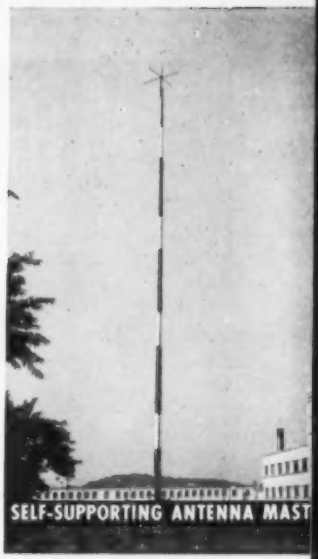
HOLOPHANE COMPANY, INC.

Lighting Authorities Since 1898

342 MADISON AVENUE, NEW YORK 17, N. Y.

THE HOLOPHANE CO., LTD., THE QUEENSWAY, TORONTO 14, ONT.

*Trademark



We're Celebrating, too...

50 years of experience in pole design and manufacture

SUPERIOR strength . . . attractive appearance . . . broadest line of designs . . . unmatched experience in pole construction. Four all-important features that make Monotube poles *your best buy* for every outdoor need.

For complete-line catalogs or helpful advisory service, write to The Union Metal Manufacturing Company, Canton 5, Ohio.

Congratulations to the IES on fifty years of lighting-engineering progress.

1906 *Fiftieth Anniversary* 1956

UNION METAL

Monotube Poles

THE LIGHTING SYSTEM THAT
goes together on the floor

...and saves 50% on Installation costs

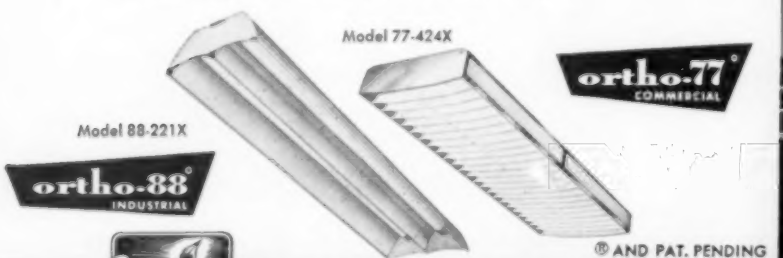
The new Gibson ORTHO Fixtures mount on a special channel called the UNI-RACE. In the photo above, the telescoping sections of the UNI-RACE are being assembled on the floor in a matter of minutes. The receptacles which come with each 4-foot section are connected as shown in the inset. The light but rigid UNI-RACE in 24′ to 48′ lengths is easily lifted and hung directly on joists, beams or stems. The fixtures simply snap into place on the UNI-RACE which holds them in perfect alignment.

An easier, faster and far better job! Is it any wonder that contractors report savings of more than 50% in labor and materials on Gibson ORTHO Installations?

Wouldn't you like more information about this totally new concept in industrial and commercial lighting design? Drop us a line today. We'll send you the whole story.

SNAP—IT'S UP • Connection is made through a built-in plug in the fixture which engages the receptacle in the UNI-RACE. Any fixture may be put up or taken down at will without interrupting other fixtures on the circuit.

VARIABLE SPACING • ORTHO units may be mounted in continuous rows or spaced at intervals of 4, 8, 12 or more feet. Fixtures may be added, removed and rearranged any time by one man without tools.



® AND PAT. PENDING

Gibson LIGHTING

GIBSON Manufacturing Co.

How to take the worry out of tough lighting problems

When you have a tough lighting problem, we can't promise a light-handed solution—but we can tell you the easiest possible way to get an answer.

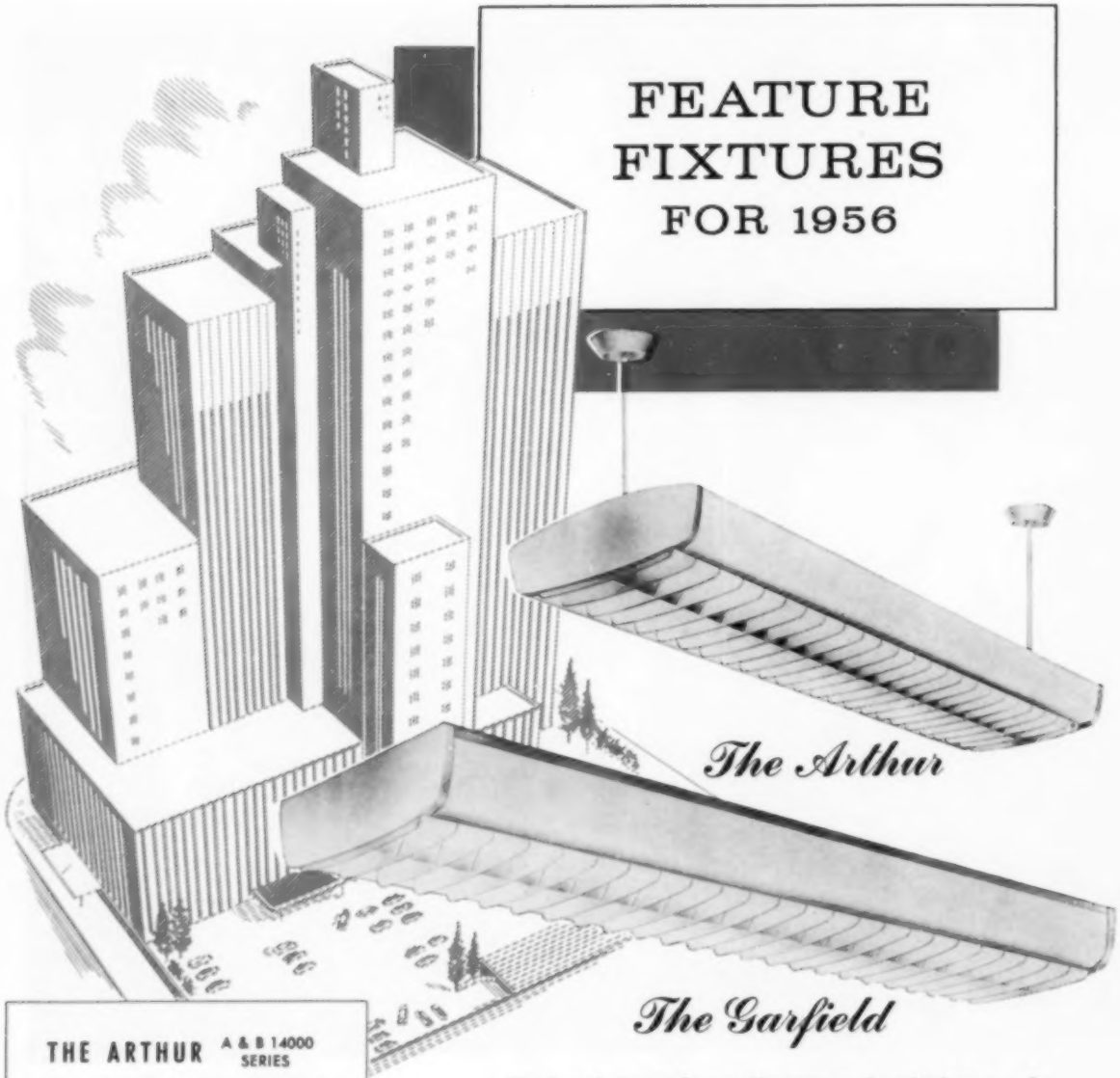
All you have to do is define your problem, state your objectives and ask us to take over. Lighting research is our forte. It has been since 1868, when we started looking for ways to improve railway signals—and got the answers. Since then, we have also found answers to airport, traffic, navigation, street, stage, studio, auditorium and many other special lighting problems.

We may answer *your* problem with a new lens design or a new kind of glass or a combination of both. We invite you to turn *your* light control problems over to our lighting laboratories. Modestly stated, we believe we have the experience and the people and the facilities that can give you an answer. The *right* answer, of course.

CORNING GLASS WORKS, 33-9 Crystal Street **CORNING, N. Y.**

Corning means research in Glass

FEATURE FIXTURES FOR 1956



THE ARTHUR A & B 14000 SERIES

A versatile direct-indirect luminaire for individual or end-to-end pendant mounting. The Arthur is available in 4-foot and 8-foot lengths, in 2 or 4-lamp models. Trim, shallow lines, all white finish, diffused polystyrene side panels and 35° x 35° shielding.

THE GARFIELD A & B 13000 SERIES

The 2 and 4-lamp Garfield is a companion unit to the Arthur, except that it has been especially designed for surface mounting. The long, low lines give it a "built-in" look and make it ideal for surface mounting on low ceilings. Diffusing polystyrene side panels and 35° x 35° shielding.

Pittsburgh Permaflector Fluorescent Luminaires are the *first* choice among men who recognize the need for versatility and flexibility in lighting equipment. That's why so many of today's buildings are illuminated with Pittsburgh Permaflector Equipment. In Pittsburgh Luminaires you find modern styling, plus high overall efficiencies . . . and you find a *complete* selection of equipment that is economical in initial cost, easy to install and maintain, and gives maximum efficiency through its long service life.

WRITE The 12-page Bulletin N tells the full story of the gracefully styled Garfield and Arthur Luminaires for direct or indirect lighting.

PITTSBURGH REFLECTOR COMPANY

411 OLIVER BUILDING, PITTSBURGH 22, PA.

In Canada: Holden Lighting Ltd., 105 Tycos Drive, Toronto

REPRESENTATIVES IN PRINCIPAL CITIES • WHOLESALERS EVERYWHERE

G-E LAMPS GIVE YOU MORE FOR ALL YOUR LIGHTING DOLLARS

You'd have to search through all these cases of General Electric lamps to find even a single defect affecting performance

GENERAL ELECTRIC UNIFORMITY IS WHY—Each of these 42 cartons contains 24 G-E 40-watt fluorescent lamps. That's 1008 lamps! And they average a 99.9% freedom from physical defects that affect performance in service.

G-E LAMPS SAVE YOU MONEY—Replacing lamps that do not work properly due to physical defects can be expensive. In more ways than one. Often an electrician has to be called. That costs money. Work often suffers while the lamp is out. Even more expensive. And work is interrupted while the lamp is replaced. Add it all up and it's too much money. Make sure your lamps are free from costly physical defects by always specifying G-E lamps.

But General Electric lamp uniformity means more than freedom from defects. You can also count on uniform light output—less than 1% of all G-E 40-watt fluorescent lamps are as much as 5% below their published light output of 2500 lumens. And uniform life, too, means that after one year of service in single shift plants (2500 hours) an average of 99 out of 100 General Electric lamps will still be burning—98 out of 100 will still be in service after a year in double shift plants (4000 hours).

For more information on what uniformity in G-E fluorescent lamps means to you write: General Electric Co., Large Lamp Dept. 1E-9, Nela Park, Cleveland 12, O.

Progress Is Our Most Important Product

GENERAL ELECTRIC

MICHIGAN BANK: Guardian Building, Detroit, Michigan
ARCHITECTS: Wheeler & Becker, Detroit, Michigan
CONSULTING ENGINEER: F. A. Sando, Detroit, Michigan
ELECTRICAL CONTRACTOR: W. D. Gale Electric Company
RAMBUSCH REPRESENTATIVES: E. Burton Wolf & Associates

•

120 Rambusch Downlites give 40/50 footcandles of sunny, glare-free light over entire floor while most of lamp heat is dissipated in attic above Banking Room. Rambusch home office or field staff are anxious to help you with your major lighting problems.

RAMBUSCH DESIGNERS • MANUFACTURERS
40 WEST 13th STREET, NEW YORK 11, N. Y.

NEW OUTDOOR FLUORESCENTS!

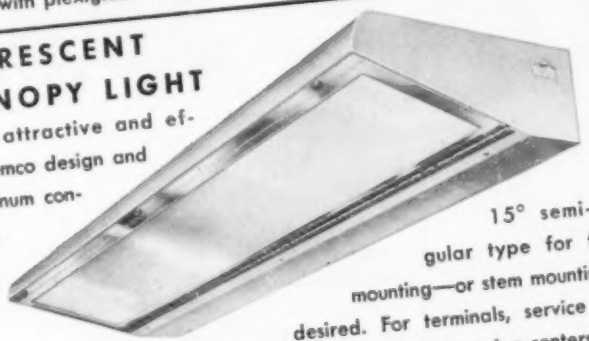
Read about 'em in the new Pemco catalog

FLUORESCENT AREA LUMINAIRE

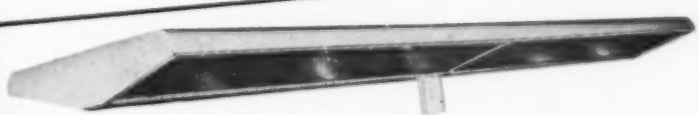
Pemco-design reflector directs the light where you want it, without loss—thus needs only ½ the lamp wattage. 2 lamp and 4 lamp models. All aluminum with plexiglass door.

FLUORESCENT CANOPY LIGHT

Rugged attractive and efficient Pemco design and all aluminum construction.



15° semi-angular type for flush mounting—or stem mounting if desired. For terminals, service stations, shopping centers, etc.



WIDE ANGLE RAPID START HORIZONTAL LUMINAIRE

Aluminum construction, in units 4' 6' or 8' long easily mounted on present poles with Pemco sliding slip fitter. Top openings for flood or spot assemblies.

- CANOPY LUMINAIRES
- FLOODLIGHTS Fluorescent Incandescent
- FLOODLIGHT BRACKETS
- ISLAND LUMINAIRES Fluorescent Incandescent Mercury Vapor
- LAMP HOLDERS & MOUNTING ACCESSORIES
- PARKING AREA LIGHTING
- POLES
- SIGN STANDARDS & SIGNS
- SPOTLIGHTS

SEND FOR YOUR COPY OF THIS NEW PEMCO CATALOG

PHILADELPHIA ELECTRICAL & MFG. CO. Dept. IE
1200 N. 31st Street, Philadelphia 21, Pa.

Please send us without obligation copy of Pemco Bulletin No. 97 ☐
We're interested in selling Pemco in our area ☐

Co. Name .....

Address .....

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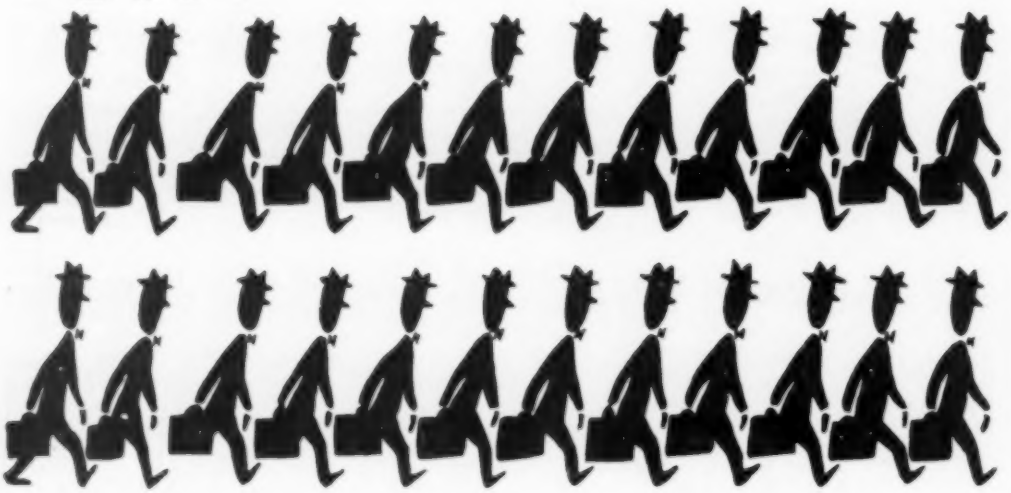
Pemco

24 out of 25 come back for more!



It's the **re-order**, not the original order that makes the customer. Whether in Detroit or Dixie, Belgium or Boston, yes, even from as far as Switzerland and Siam . . . *by actual count*, 24 out of every 25 customers re-order plastic extrusions from us.

The reason? One customer likes our quality, another our fair price, another our ability to meet delivery schedules, our designing skill. But the reason we like the best is this one offered by a customer, who upon leaving our plant said: "I like the PERSONAL INTEREST you put into the handling of each one of my orders. It's that PERSONAL INTEREST that makes me feel I can depend on Rotuba."

Our 12 years of experience processing millions of pounds of plastic materials into a variety of custom-made shapes and panels should make you feel you, too, can depend upon ROTUBA.

If we satisfy 24 out of 25, we're satisfied. We know you will be!

Extruded in Brooklyn . . . Sold 'round the World

For fast dependable service, economical, too . . . contact

ROTUBA EXTRUDERS, INC.
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SHore Road 8-5458

Makers of
PANELS • SHIELDS • DIFFUSERS
IN PLASTICS

Phila. Office
R. L. BOUSE, FLOURTOWN, PENNA.
Tel. CHESTNUT HILL 8-1010

features:
• Utilizes new 800 MA high output lamps
• May be mounted within 12" of ceiling
• Meets ASA school standards
• High adaptation level with low brightness and brightness ratios
• Flexible in arrangement
tomorrow's lighting today
PAT. PEND.
NEW SMOOT-HOLMAN LUMINAIRE
PERFECT VISION
When all cost factors are considered, Smoot-Holman's Perfect Vision indirect luminaire will be the choice for commercial, school and institutional lighting requirements. Its revolutionary "new as tomorrow" design gives more light per dollar than ever thought possible... yet continues Smoot-Holman leadership in quality and efficiency.
Investigate the many advantages of this excitingly new, architecturally beautiful luminaire. Contact your local Smoot-Holman office or write direct for Catalog PV-288.
SMOOT-HOLMAN Inglewood, Calif.
WE SUPPORT THE NATIONAL LIGHTING BUREAU
SERVICE IN THE WEST AND SOUTHWEST FOR ALL SCHOOL, COMMERCIAL AND INDUSTRIAL LIGHTING

the P&K story

HIGHWAYS

DRIVE-INS

BETTER LIGHTING everywhere

SHOPPING CENTERS

PARKING AREAS

RECREATION AREAS

AT LOWER COST to everybody

Pfaff & Kendall, originator of the Seamless Tapered Aluminum Lighting Standard and Tapered Elliptical Arm, is now producing designs and types to meet any highway, road, area, bridge and traffic signal requirement.

Wherever P&K All-Aluminum Standards and Brackets are specified and installed, the story is the same: *Fewer technical problems . . . rapid, easy installation . . . greater lighting efficiency . . . and the kind of economy you can figure in actual dollars!*

P & K All-Aluminum Standards and Brackets are always the wisest choice . . .

LIGHT WEIGHT for lowest cost installation.
NEGLIGIBLE CORROSION for longest service.
NO PAINTING means large, year-after-year savings.
SALVAGEABLE, RE-USABLE in event of knockdown.

WRITE FOR LATEST P & K CATALOG... and use the P & K planning and advisory services without obligation.

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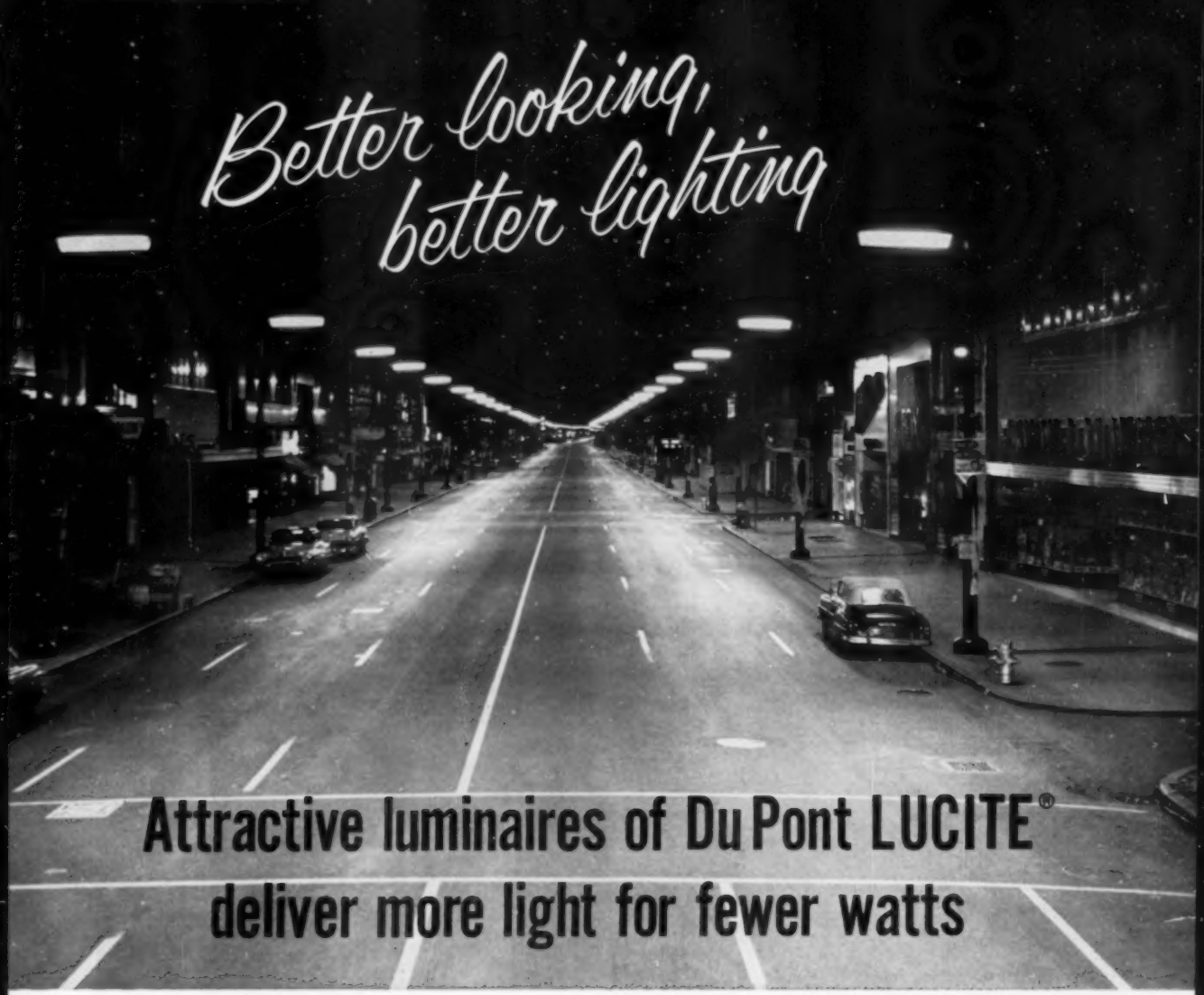
84 Foundry Street
Newark 5, New Jersey



Attractive luminaires of Du Pont LUCITE® deliver more light for fewer watts

These modern luminaires, utilizing LUCITE acrylic resin extruded by Southern Plastics Corporation, Columbia, South Carolina, are bringing more effective lighting to Euclid Avenue in downtown Cleveland . . . and doing so at reduced operating expense.

Fixtures formerly used on Euclid Avenue had two 1,000-watt lamps, dispensing 40,000 lumens. However, because there was a 50 per cent wastage, light on the street was only .7 foot-candles.

With the new luminaires, supplied by Westinghouse Electric Corporation, Cleveland, Ohio, the bulk of the 21,400 lumens from four 100-watt fluorescent tubes is directed downward, giving 1.67 foot-candles of light on the street. The new luminaires at a calculated consumption of only 256,000 kilowatt-hours per year will give more than twice the street illumination of the old lamps, which required 1,024,000 kilowatt-hours per year.

The Euclid Avenue installation represents a total investment of $55,000. The saving effected from lower maintenance and reduced use of electrical energy will amount to about $5,000 annually.

Du Pont LUCITE offers long-lasting beauty, clarity and unique light-transmission properties in all types of modern lighting installations—modular light-diffusing panels, large-area lighting, lenses for troffer and pendant luminaires, side panels and protective elements for outdoor fixtures. For complete information without obligation on how you can profit by including Du Pont LUCITE in your lighting plans, send for the free booklet, "Better Lighting with Du Pont LUCITE". Write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 289, Wilmington 98, Delaware.

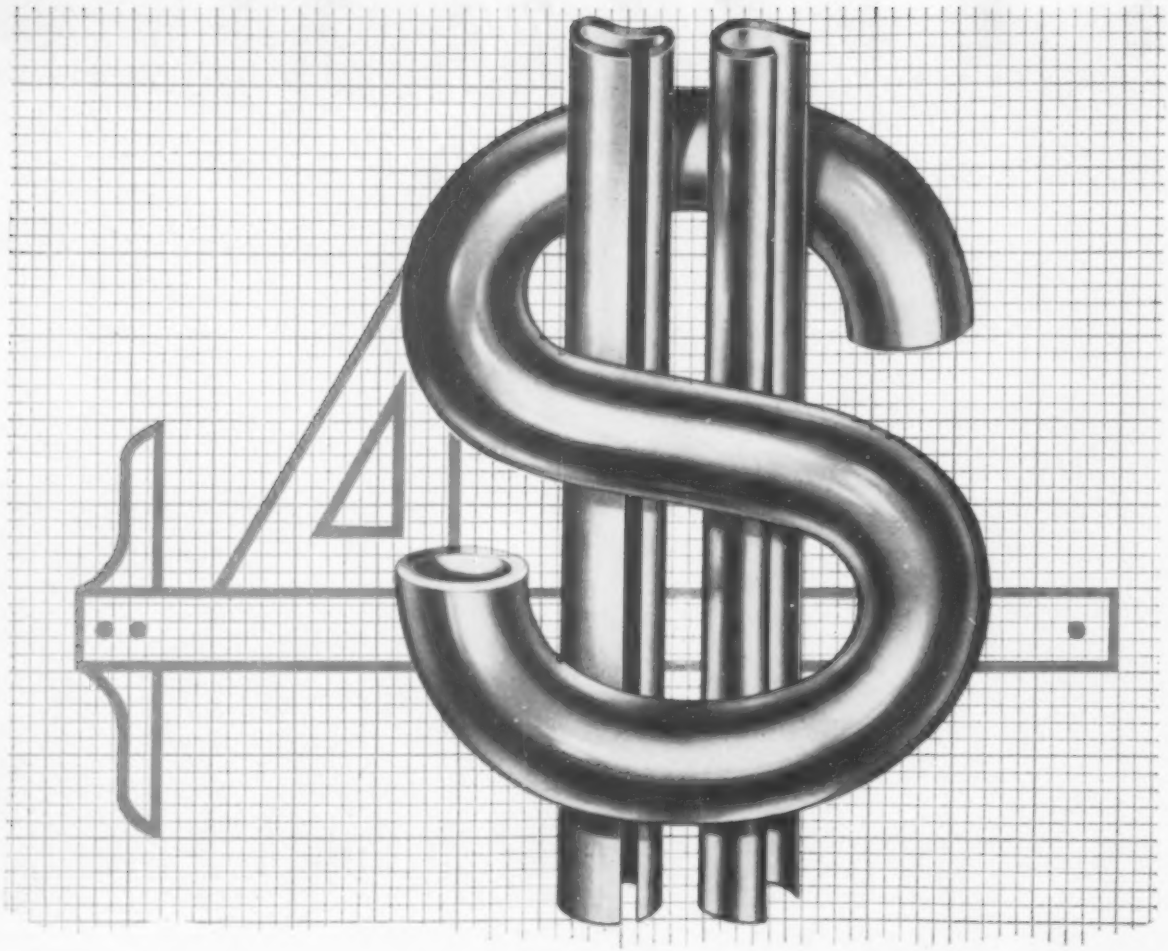
• This "Quality Controlled" label may be used only by qualified extruders of Du Pont LUCITE acrylic resin. It assures the lighting industry that the extruded material conforms to standards for low shrinkage and uniform caliper established by E. I. du Pont de Nemours & Co. (Inc.).

Quality Controlled

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY



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WE EXTRUDE PROBLEMS INTO PROFIT-MAKERS

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PRESCOLITE applies aeronautical and automotive diecasting techniques to the lighting industry for STRENGTH, DURABILITY, APPEARANCE!
The fixtures illustrated above, and many others too, employ "DieLux"* die castings as an integral part of the unit. 1. No. 1015-6715 Recessed. 2. No. A-14 Swivel Unit. 3. No. 8585 Hospital Light. 4. No. WB-25 Wall Unit.

**"DieLux"* • • • *(PRESCOLITE'S trade name for precision die cast products.)*

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Eastern RECTILINEAR ILLUMINATION

GIVES TROFFER APPEARANCE —
TROFFER LIGHTING PATTERNS —
without
TROFFER EXPENSE

Available with
PLASTIC DISH TYPE LENS
OR
PLASTIC LOUVER
WITH

2 or 4 40-Watt T12 Rapid Start Lamps
or
4 20-Watt T12 Trigger Start Lamps

These 2 Eastern units unquestionably represent the year's first advancement in commercial lighting. Here you have abundant, glare-free illumination from a unit that is less than 3" deep. In addition, virtually every geometric lighting pattern known to engineering can be achieved with these units, yet the cost is far less than a troffer installation.

Before you buy lighting, be sure to get the facts about Eastern's Rectilinear Illumination — you'll be glad you did.

Eastern ENGINEERED

EASTERN FIXTURE COMPANY
170 VERNON STREET, BOSTON 20, MASSACHUSETTS

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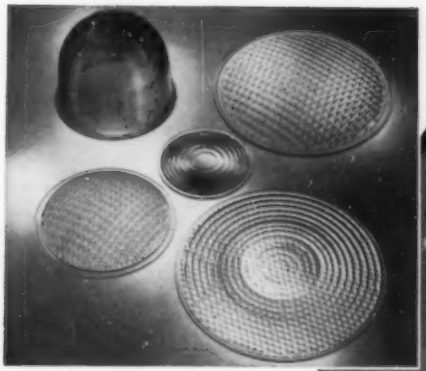

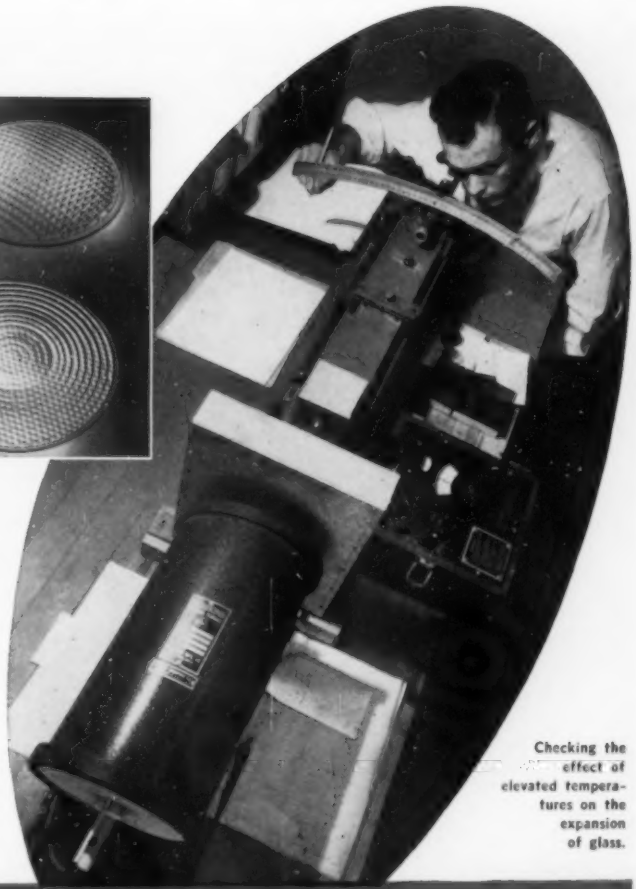

Checking the effect of elevated temperatures on the expansion of glass.

For
assured accuracy of
BEAM CONTROL
and
COLOR TRANSMISSION

Specify **Kopp Lenses**

Various types and designs of signal lenses arranged for comparative examinations.

These characteristics in varying degrees and combinations are vitally important in applications of lighting and glassware. The knowledge and ability required to develop exact light distribution and color values takes years to obtain. Kopp offers you this technical background, plus highly-organized manufacturing skills, modern production methods, and a rigid inspection procedure. Regardless of whether your problem is simple or highly complex, our engineers will be glad to submit a design to do the job.

We'll be happy to have you put us to the test—without obligation.

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KOPP GLASS, Inc.

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UNIVERSAL BALLASTS . . . a tradition of quality

A complete quality line of fluorescent ballasts for Residential, Commercial and Industrial Applications. Request our Catalog UMC-7-55 for helpful procurement data.

PREHEAT • TRIGGER START • RAPID START • SLIMLINE

Specify with confidence!

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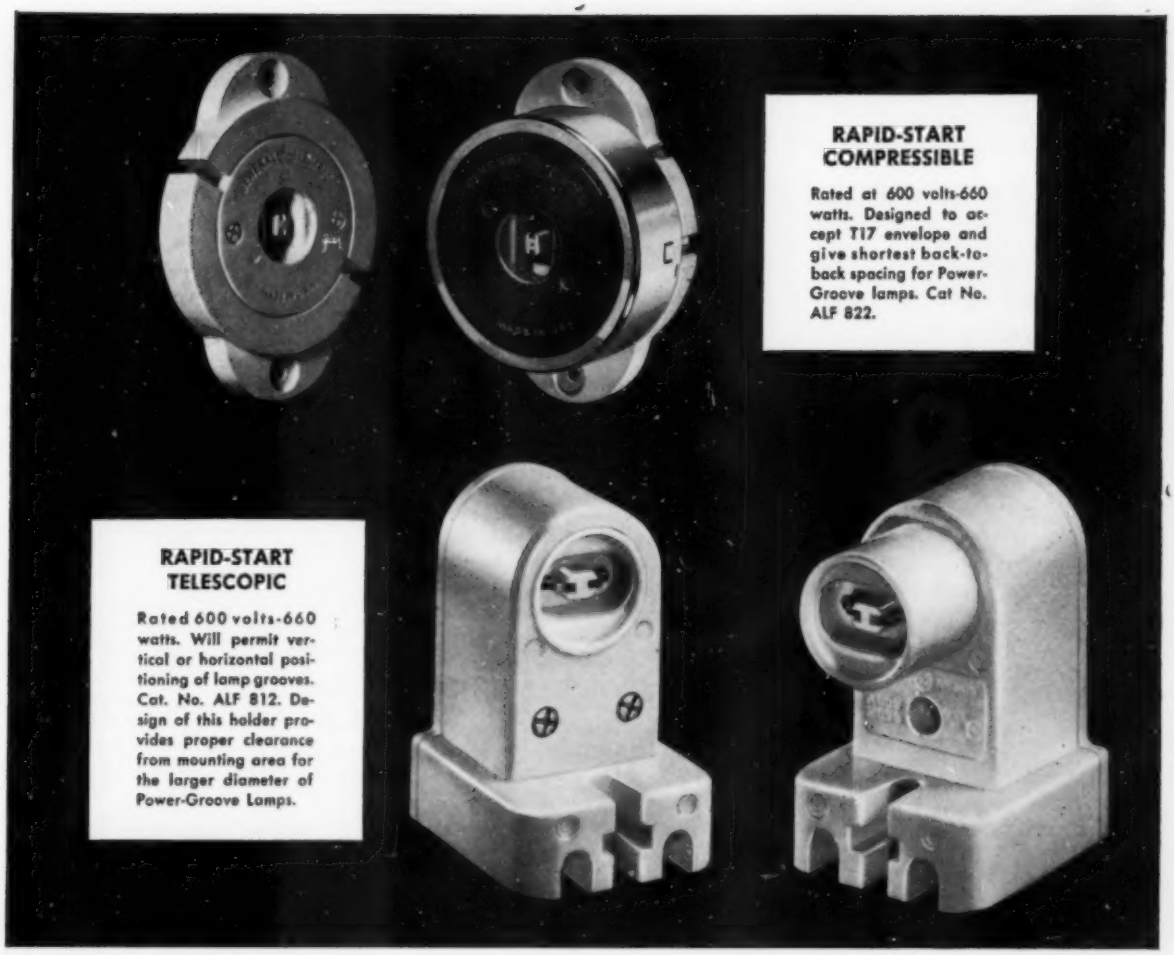

RAPID-START
COMPRESSIBLE
Rated at 600 volts-660 watts. Designed to accept T17 envelope and give shortest back-to-back spacing for Power-Groove lamps. Cat No. ALF 822.
RAPID-START
TELESCOPIC
Rated 600 volts-660 watts. Will permit vertical or horizontal positioning of lamp grooves. Cat. No. ALF 812. Design of this holder provides proper clearance from mounting area for the larger diameter of Power-Groove Lamps.

NEW HOLDERS DESIGNED FOR POWER-GROOVE FLUORESCENTS

General Electric announces telescopic and compressible lampholders compatible in size and weight with new F48TG17/RS Power-Groove Lamps

The rugged construction of these new holders gives them greater strength than existing units. Yet minimum back-to-back dimensions of the compressible type sharply reduce dark area. Both units feature double wiping silver-plated contacts adequate for new, higher lamp currents. See illustrations for details.

Information on this new family of General Electric fluorescent lampholders can be obtained by addressing Accessory Equipment Department, General Electric Company, Bridgeport 2, Connecticut.

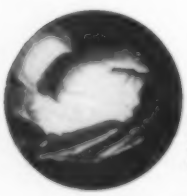
Progress Is Our Most Important Product

GENERAL ELECTRIC

Ask these questions, too, when you judge a fluorescent lamp...

Is your investment protected?

Check Westinghouse Fluorescent Lamps against any other brands you are now using. Check them for maintained brightness, long life, uniform appearance. If you are not entirely satisfied on all counts, your full purchase price will be refunded.



Is it built for good "lumen maintenance"?

Made exclusively with deterioration-resistant Halo Phosphors, Westinghouse fluorescent lamps *maintain* high light output to the end of their long lives.

Is it the correct type, size and color for the lighting job to be done?

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. Colors include seven different shades of "white" alone.

For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative.

WATCH WESTINGHOUSE

WHERE BIG THINGS ARE HAPPENING FOR YOU!

ABOUT PEOPLE

Appointment of **Richard J. McIntyre** to the new position of manager of sales, distributor and outdoor ballasts at the General Electric Co.'s Ballast Department, Danville, Ill., has been announced. Mr McIntyre comes to the Danville plant from Cedar Rapids, Iowa, where he was manager of equipment and specialty sales at the company's apparatus sales office.

Ekco Products Co. has announced the purchase of Ruby Lighting Co. of Los Angeles and Dallas. **Robert L. Lang,** recently appointed vice-president of the Ekco parent company, and **Ralph Simon** have been elected chairman and president respectively of the Ruby Lighting Co. **Albert Jassin** and **Morris Kagin** have been elected executive vice-presidents respectively in Los Angeles and Dallas.

Day-Brite Lighting Inc., St. Louis, Mo., announces the election of **James F. Mahoney** as President and General Manager of the company's wholly owned subsidiary, Day-Brite Lighting, Inc. of California. Mr. Mahoney was formely Executive Vice-President of Gladding McBean & Co., manufacturers of ceramic products. For the past year he has been president of his own management consulting firm in Los Angeles.

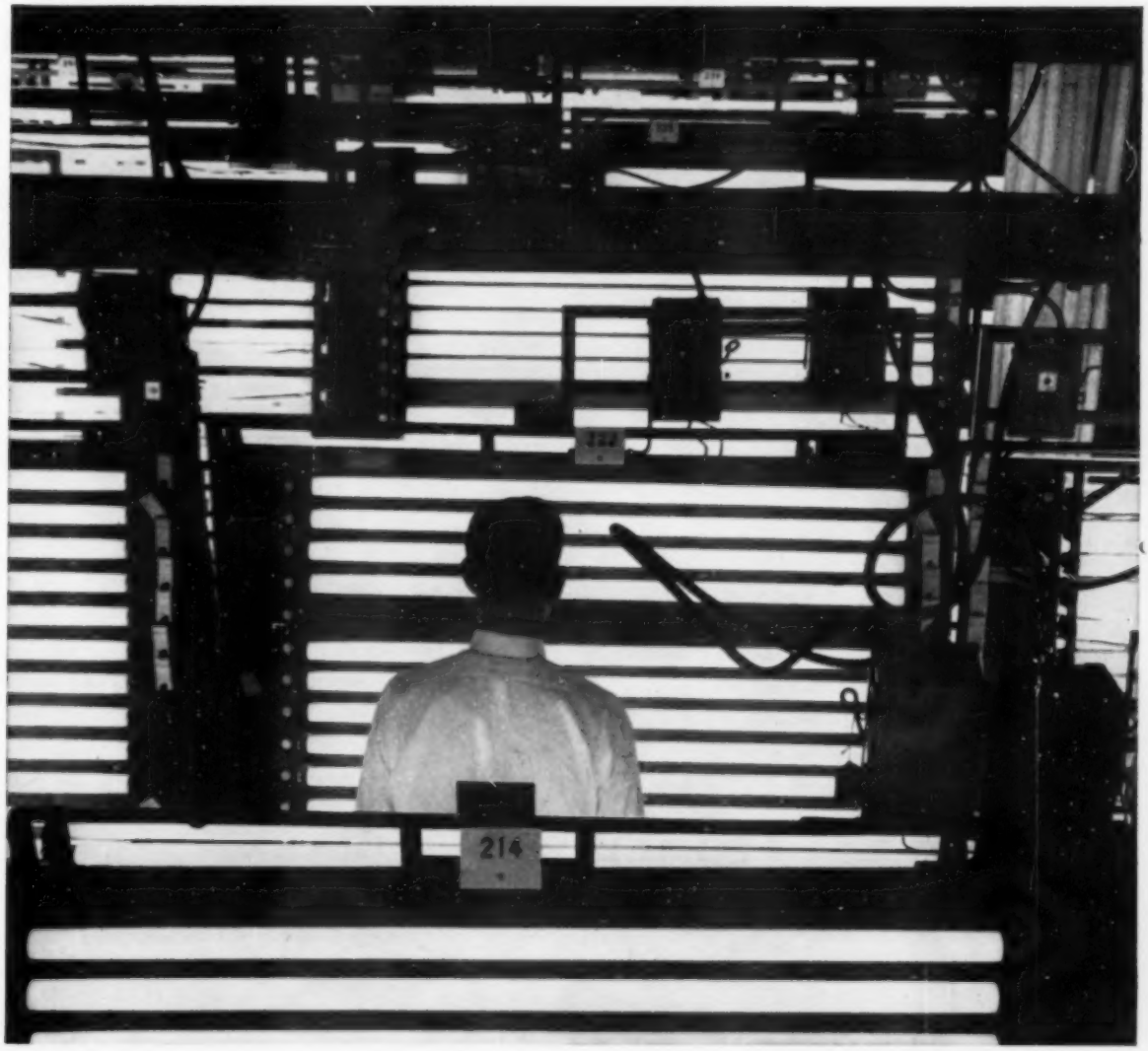
Dr. George H. Hickox, formerly program director for engineering sciences with the National Science Foundation, has been named director of research at the Army Corps of Engineers Research and Development Laboratories, Fort Belvoir, Va. His appointment completes a newly-established three-man civilian directorate which also includes a technical director and a director of development.

Two service laboratories have been opened on the West Coast by Sylvania Electric Products Inc. Both are located at the company's new Southern California distribution center at 6505 East Gayhart St. on a five-acre site at the former Vail Air Field. One is the Receiving Tube Enginering Laboratory headed by **Carl A. Peterson,** assisted by **V. Russell Barden.** The second is the Special Lamps Application Laboratory, which is under the direction of **Richard H. Lindeberg,** Sylvania's sales service engineer for photolamps on the West Coast, who was recently named special products sales manager for lighting. He is assisted by **Ernest C. Curwen,** engineer-in-charge of the laboratory operation.

(Continued on page 60A)

CONTEST CHAIRMAN and six students who received awards at the New York Section's Residence Lighting Forum's 1956 Lighting Design Competition. Left to right: Marion Seitz, Chairman of the Competition and Chairman-Elect of the Forum; Audrene Moreno-Leal; Ann Zadra; Arlene Sabetsky; Nilda Bonilla; Marilyn Sacrowitz and Dory Orama.

how to judge a fluorescent lamp . . . point no. 7



ask about QUALITY CONTROL

You would never guess it from their price, but fluorescent lamps today are *precision* products. (In Westinghouse fluorescent lamps, for example, you'll find mercury measured with the precision of a doctor's prescription, electrodes wound with fine-watch accuracy.) Thus only the closest quality control can give you the high light output, the long life, the good color qualities you expect from every single lamp you buy. Westinghouse quality control includes *480 inspections and tests* for every lamp produced.

WATCH WESTINGHOUSE

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

Now **EVERY** community can have reliable **FULLY AUTOMATIC** street light control

ABSOLUTE STABILITY WITH NO CALIBRATION DRIFT

•

OMNI-DIRECTIONAL LIGHT SENSING

•

NO ORIENTATION NECESSARY

•

PLUG-IN FEATURE ON ANY LUMINAIRE OR POLE

•

RELIABLE IN ANY WEATHER OR CLIMATE

NEW LUMATROL® MODEL S

Employing the latest developments in electronics, this new control offers more reliability than ever and promises greatly reduced maintenance costs. Because it is logical and aesthetic, the LUMATROL method of mounting has set new standards for automatic controls.

Progressive utilities and municipalities specify LUMATROL.

WRITE TODAY FOR BULLETIN.

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GARDEN CITY PARK, L. I., NEW YORK
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(*Continued from page 58A*)

F. I. Wilson, sales manager of the Wakefield Co., Vermilion, Ohio, has announced the appointment of **Daniel A. Schisler** as assistant sales manager. Mr. Schisler advanced to the main office from the Dallas, Texas, district which included Texas and Oklahoma. The latter is now covered by **Jos. E. Comer,** Oklahoma City. **Wm. J. Laughlin** will handle southern Texas from Houston. **Chas. E. Robison, Jr.,** of Huntington, West Va., is moving to Dallas to take over the immediate territory, while **R. E. Winget,** formerly with Graybar in Abilene, Texas, is now in Cincinnati to handle Mr. Robison's former district.

The Pittsburgh Corning Corp. announces the appointment of **Dr. Bruno Alter, Jr.,** to its Research and Development Division at Port Allegany, Pa. Dr. Alter was formerly an instructor of Physics at Rutgers University and the University of Wyoming.

Robert C. Harper has been named director of Pacific Coast sales for Sylvania Electric Products Inc., and will have headquarters in the company's sales offices in San Francisco until the new Sylvania distribution center in Millsdale, Calif., is opened in the fall. A member of the Sylvania organization since 1946, Mr. Harper most recently has been western regional sales manager for lighting products.

Benjamin Electric Mfg. Co. has announced the appointment of **John W. Rayner** of Wilmette, Ill., to the position of Personnel Director. For the last three years Mr. Rayner has held the position of Industrial Relations Manager for Mitchell Mfg. Co., Div. of Cory Corp., Chicago, Ill.

Advance Transformer Co., Chicago, announces the appointment of **William M. Walsh** as sales representative for the Midwestern Region. He will make his headquarters at the company's offices at 2950 N. Western Ave., Chicago.

Dr. Richard Feinberg has resigned as of September 1 as vice-president and dean, Illinois College of Optometry and has become associated with the Titmus Optical Co., Petersburg, Va., where he is assistant to the president.

Negotiations have been completed by Cutter Laboratories in acquiring all the outstanding common stock of the Geo. A. Coleman Co., Inc., owners of Pacific Plastic Products of San Francisco. The company will continue to operate under a

wholly-owned Cutter subsidiary, with **Robert Greenhood** as president.

Dr. Frank A. Grant, a physicist, has joined the staff of the Mineral Products Division of the National Bureau of Standards. Dr. Grant will do research on the semiconducting properties of titanium dioxide and titanates.

Steber Manufacturing Co., Broadview, Ill., has appointed the Upstate Lighting Fixture Sales, Inc., 259 Kensington Place, Syracuse, N. Y., as sales representatives in the state of New York, not including New York City and environs. Principals of the company are **Francis J. Sullivan, Harvey S. Kolts** and **Anthony Marsella.**

William C. Faust has been appointed manager of public relations for the Electric Storage Battery Co., and will handle employee publications as well as institutional and financial public relations for the company.

McPhilben Lighting Co. has announced three new sales representatives. **Warren McFarlane** of Oklahoma City, Okla., has joined Traweek-Healy & Associates and represents the company in Oklahoma and northern Texas. **Robert Cardwell** of Upland, Chester, Pa., has joined J. B. Derr Associates and represents McPhilben in the state of Delaware. **James A. Farmer** of Miami, Fla., is now associated with Ken H. Hill and covers southern Florida.

IT SEEMS TO ME

Brightness Limitations

"Product design is greatly affected by engineers" whose main field is not illumination. This comes about because the writers of "recommended practices," certification programs and civil codes realize that these engineers will apply them and write with them in mind. According to a prominent utility engineer, "the vast majority of these engineers" are distribution system experts without much interest . . . to go into elaborate visual analysis and would prefer . . . simple rules of thumb."

This cry for simplicity not only comes from engineers who have to deal in fields with which they are not fully familiar, but also from lay people, and the writers

(*Continued on page* 62A)

the Beauty of Inconspicuous Lighting

1500 "Magic Frame" Troffers maintain clean expanse of ceiling in new Lutheran Brotherhood Building

by Electro Silv-A-King

Here are fixtures that beautifully achieve the purpose for which they were designed —to deliver high level, low brightness contrast illumination (50 fc maintained)— yet never call attention to themselves. There are no visible screws, latches, nuts or bolts to distract the eye and the 8 ft. and 4 ft., fixtures are mounted in 20 ft. rows, with continuous glass door installation which also eliminates distracting cross bars and uneven light areas. This creates a 20-ft. "one fixture feeling" in each of the rows. In addition, "Magic Frame" Troffers provide a one piece Reflector-Wireway Cover for easier installation and maintenance.

Here, in the Lutheran Brotherhood Home Office Building in Minneapolis, is another example of how Electro Silv-A-King lighting can help translate your ideas into practice, easily and economically.

For complete data and specification catalog write to

Electro Silv-A-King Corporation

1535 So. Paulina Street, Chicago 8, Illinois
Spruce and Water, Reading, Pennsylvania

Designers and Manufacturers of the Finest in Lighting

Perkins & Will, architects-engineers, Chicago & White Plains, N.Y. Kvalsten Electric Co., electrical contractors, Minneapolis, Minn.

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A
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If you've a lighting problem . . . for hotels, schools, hospitals, industry, housing, prisons, public or office buildings . . . write us today. Our field-trained representative will be glad to discuss your needs and applications. Consult, and specify McPhilben . . . pioneer and pacemaker in cast aluminum fixtures and institutional lighting for over 41 years.
CONSULT
mcPhilben Lighting
SPECIFY
1353 Willoughby Ave., Brooklyn 37, N.Y.
CAST ALUMINUM FOR PERMANENCE, PERFORMANCE AND BEAUTY.
A 4-70 EXTERIOR WALL LANTERN
B 45R-6 RECESSED CEILING EXIT
C 43-44VT WALL VAPORTIGHT
D 32-88 SQUARE CEILING BOWL
E 53-52 HOSPITAL BED LIGHT, DIRECT-INDIRECT.

(Continued from page 61A)

of legal codes which deal with subjects that are becoming increasingly complex.

The problem that results from this desire for simplicity running head-on into the growing complexity in facts is not restricted to lighting. It is faced by all who deal with environmental conditions. P. W. Wyckoff, for example, points out in connection with air-conditioning that "the word 'horsepower' when applied to an air-conditioning compressor motor has only a vague connection with the ability of the unit to cool"; and he flatly recommends that "all (simple) restraints in the form of codes and rules, as used in a standard open-motor design are unsuitable and should be abandoned; instead, the electrical performance of each type unit should be accurately determined."

Another example comes from the field of sound. "While sound is a rapid pulsation in air pressure," quoting R. B. Garrabrant, "the intensity of which is measured in decibels, this is not the whole story. A simple decibel limitation is not satisfactory because the annoyance caused by sound waves is also influenced by their frequency (vibrations per second)."

Wyckoff's statement could be re-written thusly to apply to lighting: "The word 'brightness' has only a vague connection with the ability of a unit to light. All restraints in the form of codes and rules based on brightness are unsuitable and should be abandoned; instead, the visual performance of each type of lighting system should be accurately determined."

The reason for this is that, while light is an extremely rapid movement of photons in a wave motion, the intensity of which towards the observer is measured in candles per square inch or footlamberts, this, as with decibels, is not the whole story. Simple brightness limitations are not satisfactory because the annoyance caused by brightness is also influenced by the area of the brightness, its contrast with other areas, its position, and the adaptation level of the observer.

Until this is widely realized and accepted, and the obsolete nature of simple brightness restrictions is understood, progress in product design will tend to be redundant and sterile; and costly, inefficient methods will prevail. Brightness restrictions, operating alone, put a premium on inefficiency and result in a high cost per unit of visibility — something like burning down the house to cook the dinner.

Simplicity therefore, although often desirable, is not feasible in face of complex facts. The comment of the Urban Land Institute with respect to zoning regulations is also pertinent here, name-

ly: "A much higher degree of technical competence will be required" (on the part of writers and users of regulations) "than is prevalent today" if the best use of our knowledge and resources is to be made. The longer simple brightness restrictions prevail, the longer will product designers be unnecessarily handicapped, and the longer will a premium be maintained on inefficient, high-cost lighting methods. HENRY L. LOGAN, *Vice-President in Charge of Research, Holophane Company Inc., New York, N. Y.*

Office Lighting Practice

"The function of the *engineer* sometimes appears to be to make simple matters complex, by giving difficult answers to easy questions. The fault, however, may not lie entirely with the *engineer*. Human beings, at least in the *engineering* sphere, have a strong propensity for referring questions to a set of precepts, which they have absorbed from their environment, and for finding answers based on these precepts, without regard to rational analysis. This approach is appealing because it yields a simple answer to any question. The correct policy action then appears to suggest itself almost automatically.

"When an *engineer* insists on bringing rational analysis into the picture, the problem which had appeared so simple before often turns out to be quite complex. Policy determination, even when overall goals are known, may then be a very difficult matter. Furthermore, the whole analysis faces psychological rejection by the general public because of the complexity, and unless the weight of evidence is overwhelming, will, in fact, be rejected. One is tempted to say that human beings prefer an easy answer, even if they suspect it to be wrong, to a difficult one which they suspect may be correct."

The above paragraphs have significance for us in some of our arguments. The writer cannot claim credit for them, however, as they were written by Royall Brandis, Professor of Economics at the University of Illinois, for publication in an article on taxation which appeared in the May issue of *Current Economic Comment* of the Bureau of Economic and Business Research. For his purpose, the writer secured permission to quote the paragraphs, substituting the words "engineer" and "engineering" as italicized for "economist" and "economic."

(*Continued on page* 64A)

50" x 14' sheet extruded for SPANGLER SIGN WORKS, Philadelphia

GERLITE

EXTRUDED

Acrylic Sheet

is Big Business at GERING

This Gerlite sheet, the largest acrylic sheet ever extruded, measures 50" wide by 14 feet long and will be fabricated by Spangler Sign Works for a major oil company.

This is but another example of Gering's ability to extrude Gerlite acrylic sheets to meet every desired requirement in lighting and sign applications.

Sheets are available clear or colored, to 54" wide to .125" thick, any practical length.

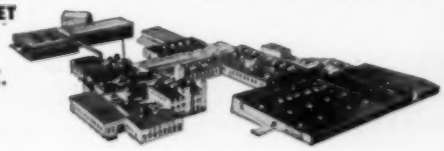
Gerlite gives long service, is weather resistant and can be painted or silk-screened with present existing paints.

GERLITE

Quality Controlled

EXTRUDED ACRYLIC SHEET

Write now for full information and prices!



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KENILWORTH, N. J.

Introducing NEW

DIRECT-THE-LITE

ADJUSTABLE

Floodlight Reflectors

. . . designed for specific area floodlighting and controlled general illumination. New DIRECT-THE-LITE units by Novelty are recommended for churches, public buildings or commercial application wherever higher intensities are required. Spot lamps or floodlamps may be used, and they are adjustable both horizontally and vertically, approximately 35°. Write for new illustrated folder.

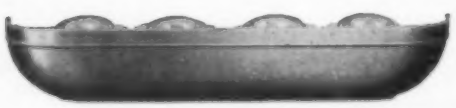
New Lighting Ideas for

• Restaurants • Lounge Bars
• Stage Lighting and TV • Theaters
• Churches (Chancel) • Arcades
• Display Windows • Store Fronts

NO. CH 215

APPROVED BY UNDERWRITERS' LABORATORIES, INC.

NO. 8264
Furnished in prime coat for painting to match wall or sprayed finish. (Available with two, three or four lamps.)



NO. 8251
Alumac finish. Canopy mounting.

NO. 8260
Furnished in prime coat for painting. Keyhole slots and center lockup.

Designers and Manufacturers . . . Since 1905

THE NOVELTY LIGHTING CORP.

2490 EAST 22nd STREET CLEVELAND 15, OHIO

(*Continued from page 63A*)

Do you find that the paragraphs particularly apply to the over-simplification of luminaire brightness control in the newly revised Recommended Practice for Office Lighting, on pages 421-422 of June IE? It is entirely possible that a careful application of this analysis would require the rejection of one luminaire, as compared with another one quite similar, even when no one could discern any difference in visual comfort as between installations of the two. LEONARD V. JAMES, *Illuminating Engineering Consultant, La Grange, Ill.*

BOOKS AND PAMPHLETS

ASTM Standards on Electrical Insulating Materials (D-9), published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 656 6x9 pages; heavy paper cover; price, $6.00.

This latest edition of the compilation of standards on electrical insulating materials sponsored by Committee D-9 on Electrical Insulating Materials includes specifications and test methods issued by ASTM. The changes since the previous edition, in 1955, comprise 12 revisions and two new items covering methods of testing silicone insulating varnishes and a recommended practice for cleaning plastic specimens for insulation resistance testing. The compilation includes 83 methods of test and specification.

Proceedings of 1955 Technical Sessions of the International Commission on Illumination (C.I.E.), 2 volumes, sewn in cloth, $15 per set.

The Proceedings of the Technical Sessions of the 1955 Zurich meeting of C.I.E. June 13 to 22, 1955 have been prepared in two volumes, each containing about 800 pages and including more than 300 black-and-white illustrations and 12 color-prints.

For easy reference all material relating to a given subject has been carefully correlated. For example, under the heading "Street Lighting" one will find the Secretariat report and individual papers on the subject, as well as a report on the discussions which took place in Zurich.

Orders should be sent to: Mr. T. D. Wakefield, Treasurer, United States National Committee, C.I.E., % The Wakefield Company, Vermilion, Ohio.

How to Make Homework Lighter, Form B-563, published by Better Light-Better Sight Bureau, 420 Lexington Ave.,

New York 17, N. Y. Price: $4.00 per hundred on quantities of less than 1000, and $35 per thousand on quantities of 1000 and more.

This 8-page booklet is designed for use by electric light and power companies in disseminating information on the application of good lighting principles to home study, and was prepared by the BLBS Home Lighting Education Committee.

Architectural Floodlighting, Bulletin GEA-6437, published by the General Electric Co., Schenectady 5, N. Y. 8 pages, no charge.

This bulletin illustrates various methods of floodlighting public and commercial buildings, fountains, industrial plants, motels, shopping centers, stores, banks, etc., and discusses four "musts" for efficient economical floodlighting installations.

Service Station Lighting, Bulletin 2689, published by Crouse-Hinds Co., Wolf and Seventh North Sts., Syracuse, N. Y. 16 pages, no charge.

Photometric data and installation information for planning and ordering

(*Continued on page 68A*)

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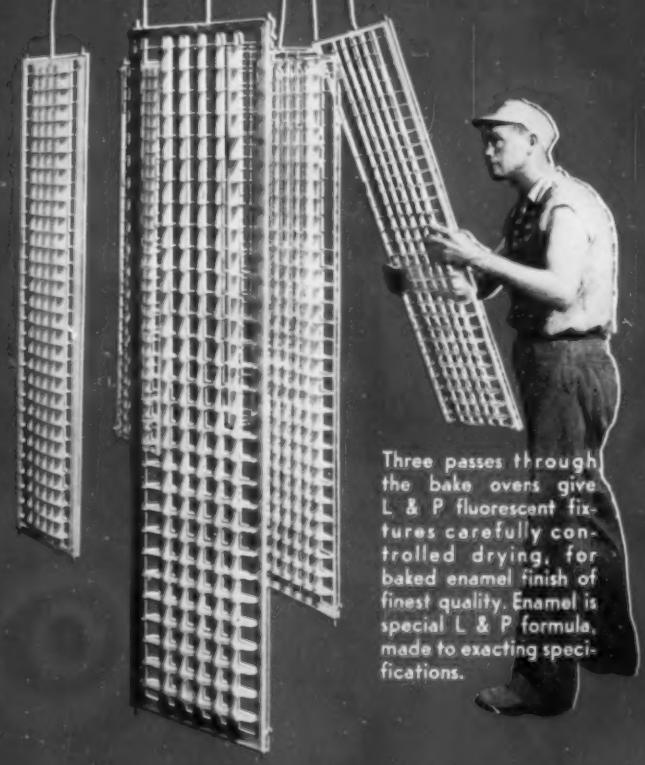

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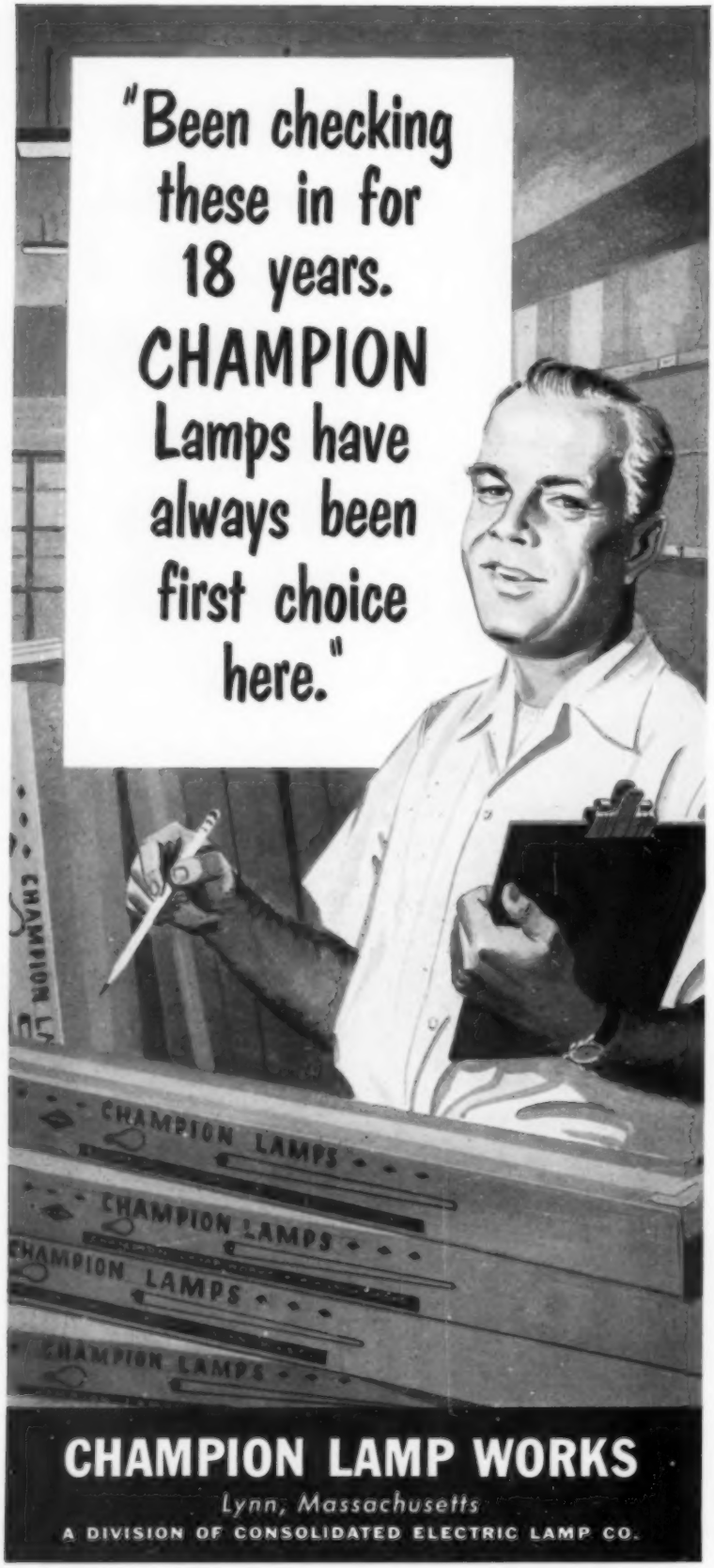
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NEW EQUIPMENT DATA

(*Continued from page* 36A)

Booklet contains full details. Lighting Products Inc., Highland Park, Ill.

20 Folder describes light-diffusing suspended ceiling panels fabricated from several different plastics materials; gives illumination and other characteristics; details code acceptance procedures. Plax Corporation, Hartford, Conn.

21 Contemporary Lighting for churches and public buildings is covered in 20-page, full-color catalog of decorative, incandescent fixtures. Catalog gives lighting details, as well as specifications. R. A. Manning Co., Sheboygan, Wisc.

22 Folders A and B illustrate new line of decorator-styled lighting fixtures in contemporary and traditional design for residential installation. Types include reel-type adjustable fixtures with pierced domes in bright brass and copper finishes. Lehrolite Co., Wallingford, Conn.

23 52-page catalog lists stock of thermoplastic and phenolic sheets, rods, tubes, and films, and miscellaneous resins, cements and supplies. Includes comparison table of chemical, electrical and mechanical properties, and lists available sizes, etc. Cadillac Plastics and Chemical Co., Detroit, Mich.

24 16-page booklet "Color Corrected Mercury Vapor Lighting for Indoor Sports and Assembly Areas" covers results of analysis of such lighting from standpoint of players, spectators, choice of equipment and lamp selection; includes illustrations of actual installations. Holophane Co. Inc., New York, N. Y.

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(*Continued from page 65A*)

floodlighting for service stations are included in this booklet with recommended layouts for revised lighting.

Outdoor Lighting, Bulletin GEA-6438, published by the General Electric Co., Syracuse 5, N. Y. 12 pages, no charge.

Booklet is intended as a guide to modern outdoor lighting for shopping centers, suburban businesses and commercial parking lots. It illustrates various applications to show how adequate lighting helps increase sales in such businesses.

Wiring for Residential Outdoor Lighting, published by the Construction Materials Division, General Electric Co., Bridgeport 2, Conn. Publication No. 15-116, no charge.

This booklet is intended primarily for the electrical contractor. The first section contains suggested uses for outdoor lighting fixtures and weatherproof outlets for the the contractor to advise his customers and plan their outdoor wiring needs. Wiring installation is included in the second section, with diagrams of various methods. Underground and overhead wiring, switch control, underwater lighting are discussed in this section. The last section includes tables, a list of wiring materials and a list of the company's other publications of interest to contractors interested in outdoor wiring and lighting.

Accident Rates, 1955, published by the National Safety Council, 425 No. Michigan Ave., Chicago 11, Ill.

Current accident rates for various industries, both major and minor, given in this booklet are based on the reports of National Safety Council member companies. The publication is prepared by the NSC Statistics Division.

American Standard Code for the Designation of Photo Lamps, C78.370-1956, published by the American Standards Association, 70 East 45th St., New York 17, N. Y. 50 cents.

This code for designating and identifying lamps used in projectors and other photographic equipment is expected to be in use on cartons and on the lamps themselves within the next few months.

Chairman of the ASA Committee which produced the code is E. H. Salter, Electrical Testing Laboratories.

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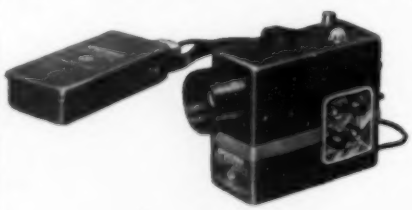

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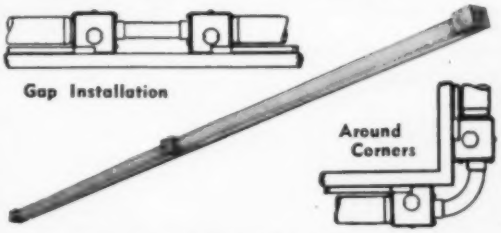

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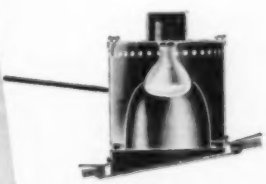

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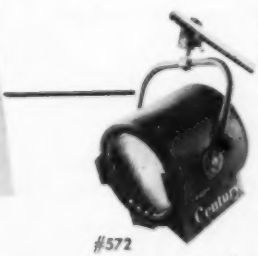

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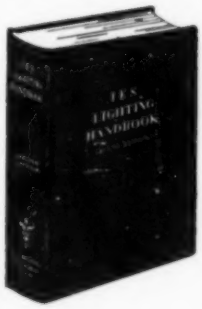

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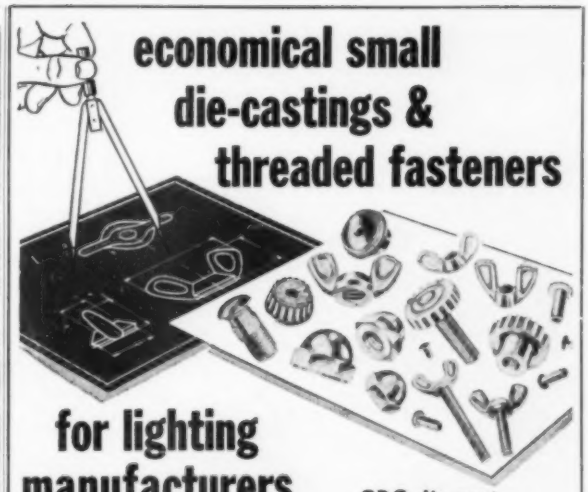

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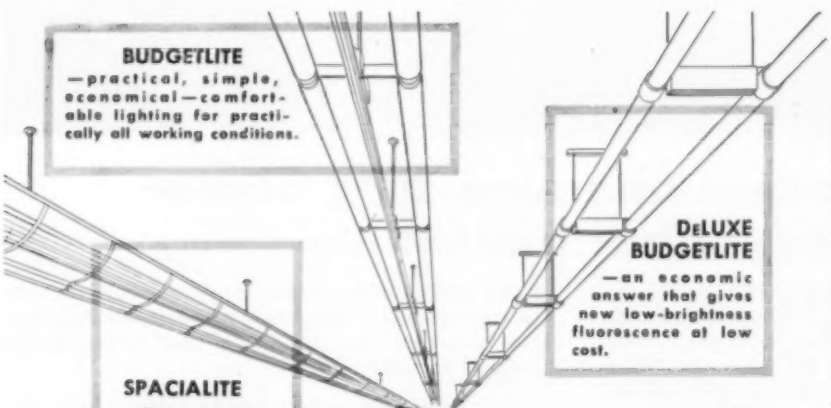
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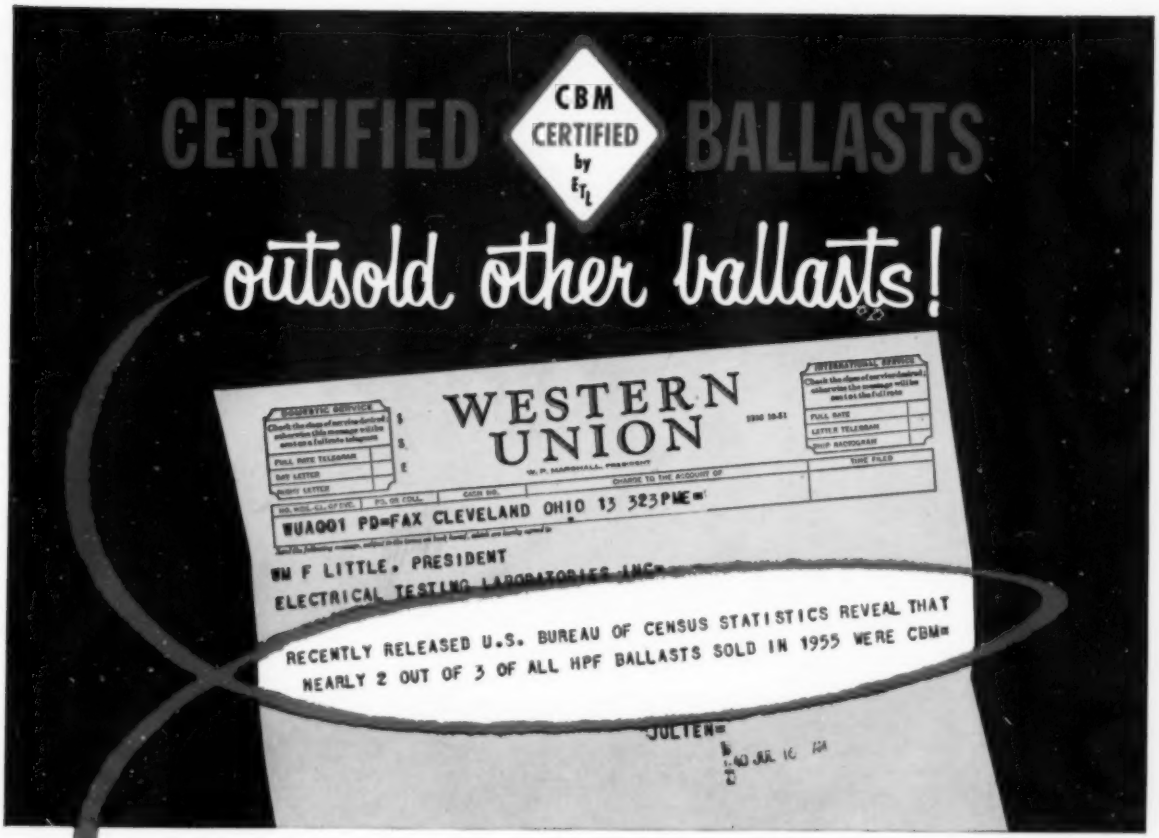
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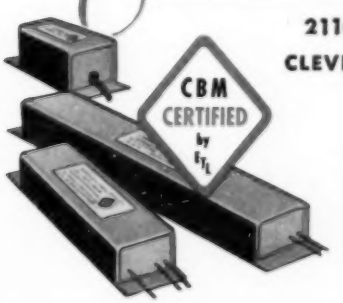

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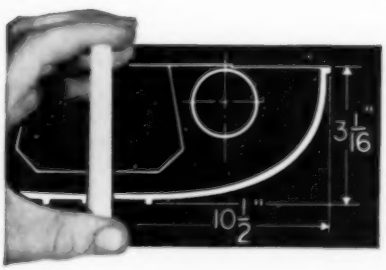
SHALLOWER than a Piece of Chalk . . . meets New IES School Lighting Practice!

Announcing the New CAPRI for Lower Cost School Lighting!



New Low Brightness! Now Benjamin brings you a new twin-lamp fluorescent unit that is shallower than a piece of chalk! Yet, the "CAPRI" meets the new IES School Lighting Practice, including even more stringent brightness control.

New Low Silhouette! In a triumph of illuminating engineering, the "CAPRI" meets these standards even though it features the slimmest, trimmest proportions and the most petite, inconspicuous silhouette ($3\frac{1}{16}$" high and $10\frac{1}{2}$" wide) of any fluorescent school lighting unit! Modern, ultra-streamlined "CAPRI" units actually help improve the appearance of school lighting jobs to an extent never before accomplished at such small cost.

New Low Price! The "CAPRI" triumphs over high school lighting costs, too! Despite its modern appearance and engineering that meets IES Practice, it is one of the LOWEST PRICED pendent-type fluorescent units on the market today. Use it with 40-w Rapid Start or 96" Slimline lamps. Sliding hangers help you circumvent pipes and duct work. Unique air circulating vent at bottom of unit keeps dirt accumulation to a minimum. Benjamin Electric Mfg. Co., Des Plaines, Illinois.

NEW LOW-PRICED BENJAMIN CAPRI

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Sold Exclusively through Electrical Distributors